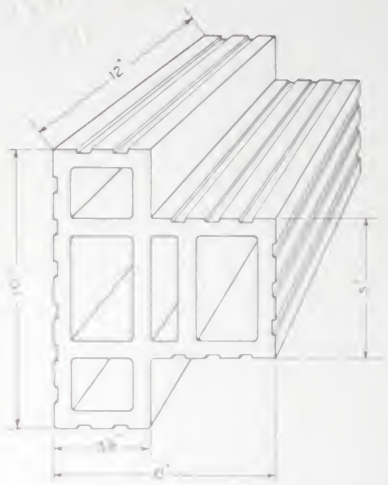
A Primer

The A. B. C. OF GOOD BUILDING



This Size Builds All Walls

This one unit is all that is required to build walls of any thickness, 8 inch, 12 inch, 16 inch or thicker.

Denison Interlocking Tile

The drawing shows the exact size of the tile we manufacture and construction details will be sent on request.

THE CLAY PRODUCT CO.

STOCK EXCHANGE BLDG. - CHICAGO, ILL.

Mr. Builder:—

YOU should use DENISON INTERLOCKING TILE in your new building because it builds the best wall. It's not the cheapest but it's very cheap for the results obtained. There are other materials some cheaper and there are many more expensive but none which will give you the satisfaction. You wouldn't build a paper house just because it was cheap, would you? Well, then take the pains to investigate INTERLOCKING TILE. We'll pay the costs of that part of it. DENISON TILE builds the best wall because it was designed by a competent engineer for that particular purpose. It builds a wall stronger than you can use because the tile interlocks. It builds a wall forever dry because it can't sweat nor absorb. It builds a wall that will not only keep rooms cool in summer, but warm in winter with 10% less fuel than you're using now because it makes a nonconductive wall. It builds a safe house because it makes a fireproof wall. It builds a structure that is just as good in ten years as when new, because the walls don't shrink or settle. It builds a wall with a stucco exterior that is absolutely permanent because it's hard burned tile. It builds a wall with a brick exterior that is more than a mere veneer because the tile is designed to accept the brick headers. Now, perhaps you don't thoroughly understand all of this and for that reason we have published for you a Primer on good construction which isn't essentially an advertisement for INTERLOCKING TILE, but which discusses the principles of good building in a non-technical way. Here it is! Read it before going further and if you wish another copy we will be glad to send it to you. We would like the opportunity of giving you further information.

A Primer of Good Building--Lesson I

STRONG WALLS

TEXT: So build that the walls endureth long without decay or depreciation.

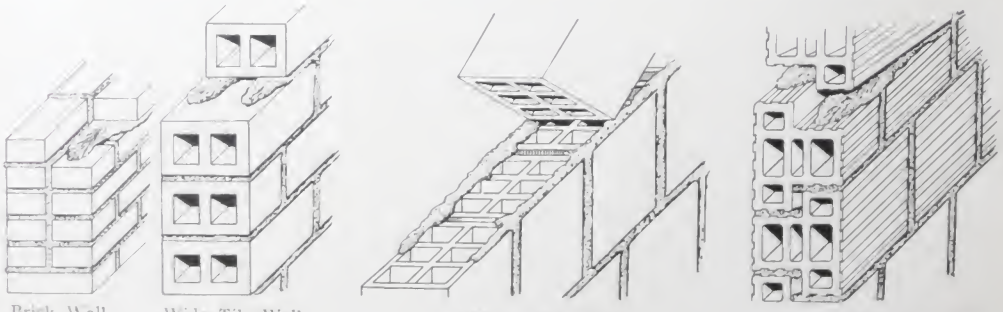
The strength of a wall depends principally upon five factors:

1. The Strength of the Component Parts. No wall can be stronger than the units composing it. Their individual strength is best determined by engineering tests. The lumber of today is so inferior that it can not be considered as a component of the best wall. The strength of concrete is variable depending so much upon the mixture and the handling on the job as to be indeterminate. To obtain their proper strength all clay materials should be hard burned.

2. The Method of Joining the Component Parts into a Wall. The strongest units will make a weak wall unless properly united. The system of joining the component parts is usually such that only a small part of the strength of each unit is utilized in the wall. In planning the joint not only the downward pressure should be considered but the constant and intermittent side thrusts and strains.

3. The Mortar Joint is commonly the weakest place in the wall. That's where walls crack. Other factors being equal the fewer the mortar joints the stronger the wall. A mortar joint which extends straight through the wall carries a weak streak through the wall.

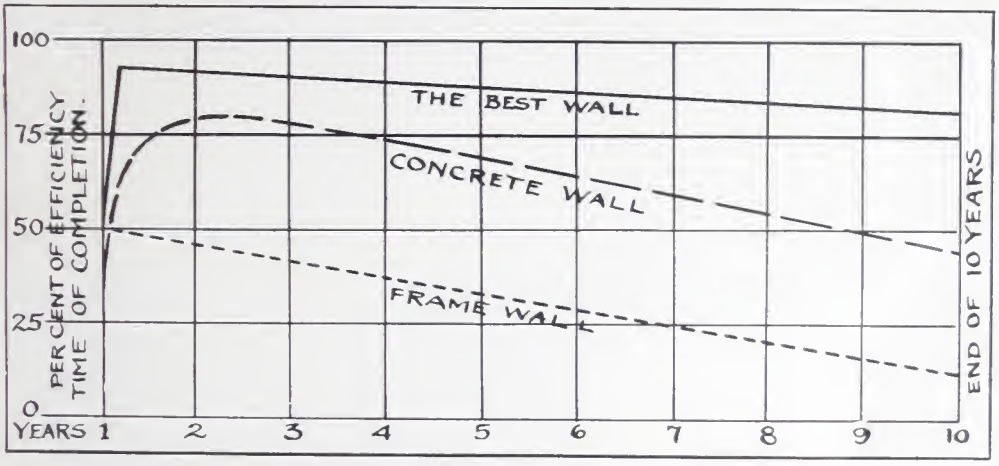
4. The Extent and Firmness of the Mortar Bed. A narrow, wabbly mortar bed, such as is made by spreading mortar on the ends of tile webs, makes a weak mortar joint. On a bed which is very broad the mason spreads a trowel full on the outside edges leaving the center of the block unbedded and unsupporting. A firm bed four inches wide is conceded to be the most efficient mortar bed. The strength of this mortar bed may be greatly increased by making dove-tail grooves in the bed so that the mortar, upon setting, forms dowels, mortising the blocks together.



Brick Wall | Wide Tile Wall | Vertical Tile Wall | Interlocking Tile Wall

Typical Mortar Joints in 8 inch Walls

5. Ability of the Wall to Resist Depreciation. To the owner this factor should be the measurement of efficiency. The time of greatest wall strength comes shortly after completion; in a frame wall it coincides with completion; in a concrete wall the "setting period" between completion and highest efficiency is very long and during this period the wall is liable to severe injury; in a tile wall the weak period is short. After reaching the peak of efficiency, all walls begin to depreciate. The rapidity of depreciation depends upon how closely the wall adheres to the principles

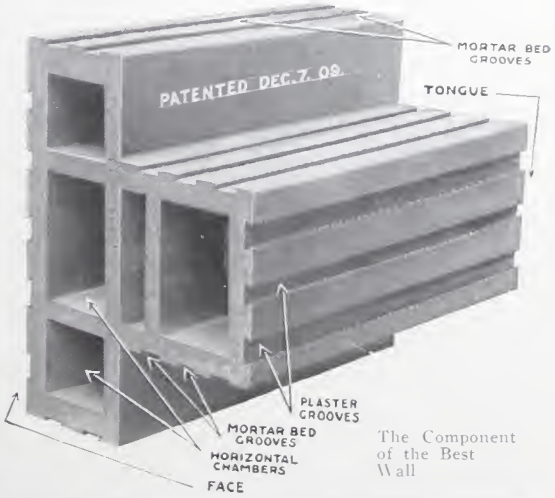


Diagramatic Representation of Rate of Depreciation

established in the following lesson.

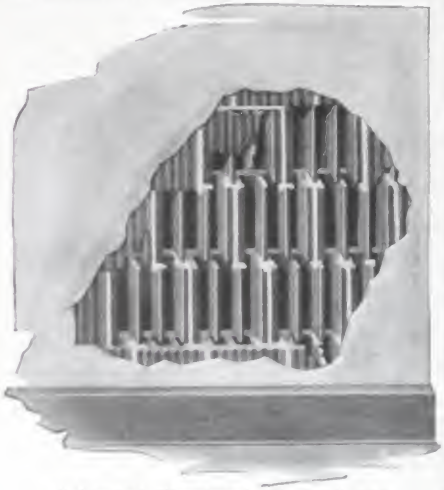
SUMMARY: The strength of the wall depends not alone upon the strength of its component parts but upon how these parts go together to withstand all strains and pressures and resist depreciation.

APPLICATION: The only material yet designed which fulfills all these requirements for the best wall, is *Denison Interlocking Tile*. Each block is hard burned and has a minimum supporting strength of 1,600 pounds to the square inch of bearing surface. The block is so designed that, when laid into the wall, each web fits firmly and directly above similar webs below.



The Component of the Best Wall

Thus the webs form continuous supporting columns from bottom to top of wall, giving a minimum supporting strength of 3,000 pounds for every available square inch of web section at the top surface. Every particle of strength in the tile is utilized in the wall. This is a condition impossible to meet with a vertical chambered tile, for in order to break joints between tiles, a majority of the webs fall over the voids below and lose their supporting strength. In a vertical chambered wall the only webs which give any support to the wall are those paralleling the face of the wall.



A Vertical Chambered Tile Wall with Facing Shell Removed to Show Failure of Webs to Support Each Other

The size of Denison Tile allows the elimination of four-fifths of the mortar joints as compared with brick construction.

Denison Tile furnishes a solid four inch mortar bed space on which adjacent tiles bed firmly.

Denison Tile interlocks so that no mortar joints extend through the wall; thus the weakness of mortar joints is largely removed. But a small part of the burden on a bearing wall is thrown there as a direct downward pressure but as an outward or inward thrust, bearing against a single course of tile. If the course receiving such a strain adheres to the one below with a through mortar joint this joint must bear all the strain. With Denison Tile walls such a side thrust is borne by the opposing lug of the tile below, thus relieving the mortar joint and transferring the side strain into a resultant downward pressure.

PROOF POSITIVE—8" Walls—Laid up at the same time—same mortar—stood three months—Jack Screw Did the Rest

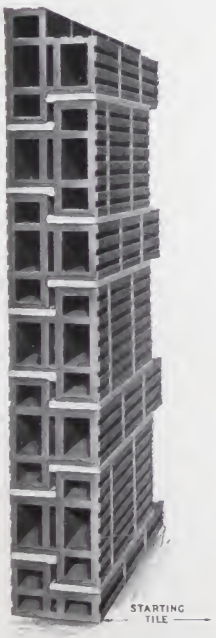
To further strengthen the mortar joint, all bedding surfaces on Denison Tile are made with deep dove-tail grooves allowing the mortar to set in dowels firmly mortising adjacent courses.

CONCLUSION: The application of all these principles for a strong wall into the design and manufacture of Denison Tile have determined a wall upon which floor and roof thrusts, sudden shocks, wind pressures and heavy loading have the minimum effect toward developing cracks or weaknesses and

produces a wall reinforced against depreciation. The other elements causal to deterioration, temperature and moisture resistance, and fireproof qualities must be dealt with in further lessons.

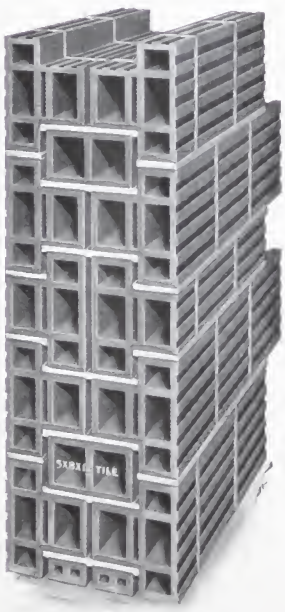
The unique shape of Denison Tile renders possible the erection of walls of varying thicknesses, 8-inch, 12-inch, 16-inch, and so on, all of the same size tile. All other forms of tile construction require individual units for each thickness of wall, resulting in the accumulation of "left over" tile of the different thicknesses on every building.

There is also the added advantage in using the one shape and size that the uniformity permits more speed in laying up.



Eight Inch Wall

Twelve Inch Wall



Sixteen Inch Wall

DENISON INTERLOCKING TILE WALLS ALL MADE WITH THE SAME TILE

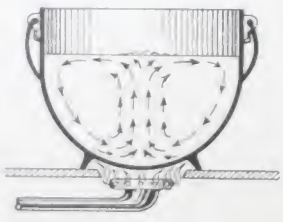
NON-CONDUCTIVE WALLS

TEXT: So build that the outer walls will protect you from the extremes of outside temperature.

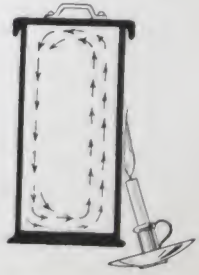
There are two ways by which heat may penetrate building walls:

1. By Conduction or direct transference of heat energy through a solid substance. The surface of a solid wall takes on the temperature of the air next to it. This heat is conducted into the wall until the whole wall is heated to the temperature of the warmest surface. Then the wall has become a radiating medium through which the heat flows uninterruptedly. If it is winter and fuel is burning to heat the air of the rooms, it must at the same time heat the walls and flow out through them. After solid walls become heated through, in the summer time, the outside temperature is rapidly established within and the walls continue radiating their heat so that even during a cool night the room's temperature hardly decreases. In order to prevent such conduction of heat, some form of air space must be inserted within the wall. Air is the poorest conductor of heat and hence is utilized to prevent conduction through walls. The air space is built into the wall in various ways: sometimes as merely a single large air space; sometimes as small non-communicating air spaces; and other times by inserting some such fibrous substance as felt, hair or mineral wool, which contains within its meshes infinite small air spaces. The most efficient insulation is produced by relatively small non-communicating air chambers because large air spaces not only admit, but aid in the transmission of heat by means of convection currents.

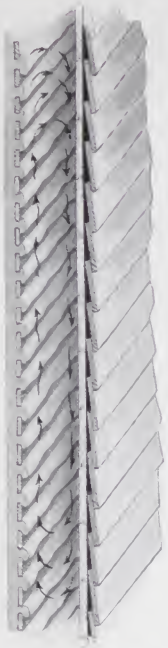
2. By Convection or the conveying of heat by means of some circulating medium. The simplest application of this principle is in boiling water. When the water at the bottom of the kettle gets hot it rises and cooler water falls to take its place, it in turn rising as it is heated, thus conveying the heat to the surface and sides of the kettle. A chamber of air acts in the same way. If a wall contains air chambers which communicate vertically, there is a free circulation of air within the wall. This is just the undesired result, for when attempt-



Convection Currents in a Water Vessel

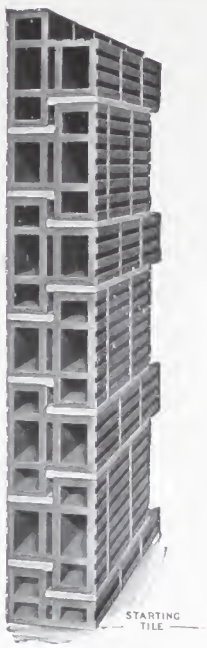


Convection Currents in an Air Chamber



The Wrong Way—
Making a Truly
Conductive Wall

ing to heat the rooms, the inner surface of the wall is heated, the air lying next to this surface within the chamber is heated, rises and as it falls, conveys the heat which should be in the room to the out-of-doors. The reverse circulation results in conveying the hot summer temperature to within doors. In order to prevent this condition, the air chamber should be divided horizontally so that convection currents can not exist, thus making *dead air spaces.* If then the horizontal chambers are divided vertically, so as to leave two or three dead air spaces between the inner and outer surfaces of the wall, as nearly a perfect non-conductive wall as is yet known is established. Such non-conductive wall construction has long been used for refrigeration and cold storage plants, but their application into general building is not practised as generally as it should be. Why should the tomato and its associates receive better protective consideration than you and your associates? The practical results of a non-conductive wall are interesting: If the inner shell of the wall is a dense material it will take on at once the temperature of the room and change immediately with every slight change of room temperature. On account of the complete insulation from the outer wall shell there is an imperceptible loss of heat through the wall, the winter fuel bill will be greatly reduced. The reverse condition is applicable to summer and the inner temperature should never be higher than the cool night air, if wall openings are kept closed during the day.



The Right Way—
Making a Truly
Non-Conductive
Wall

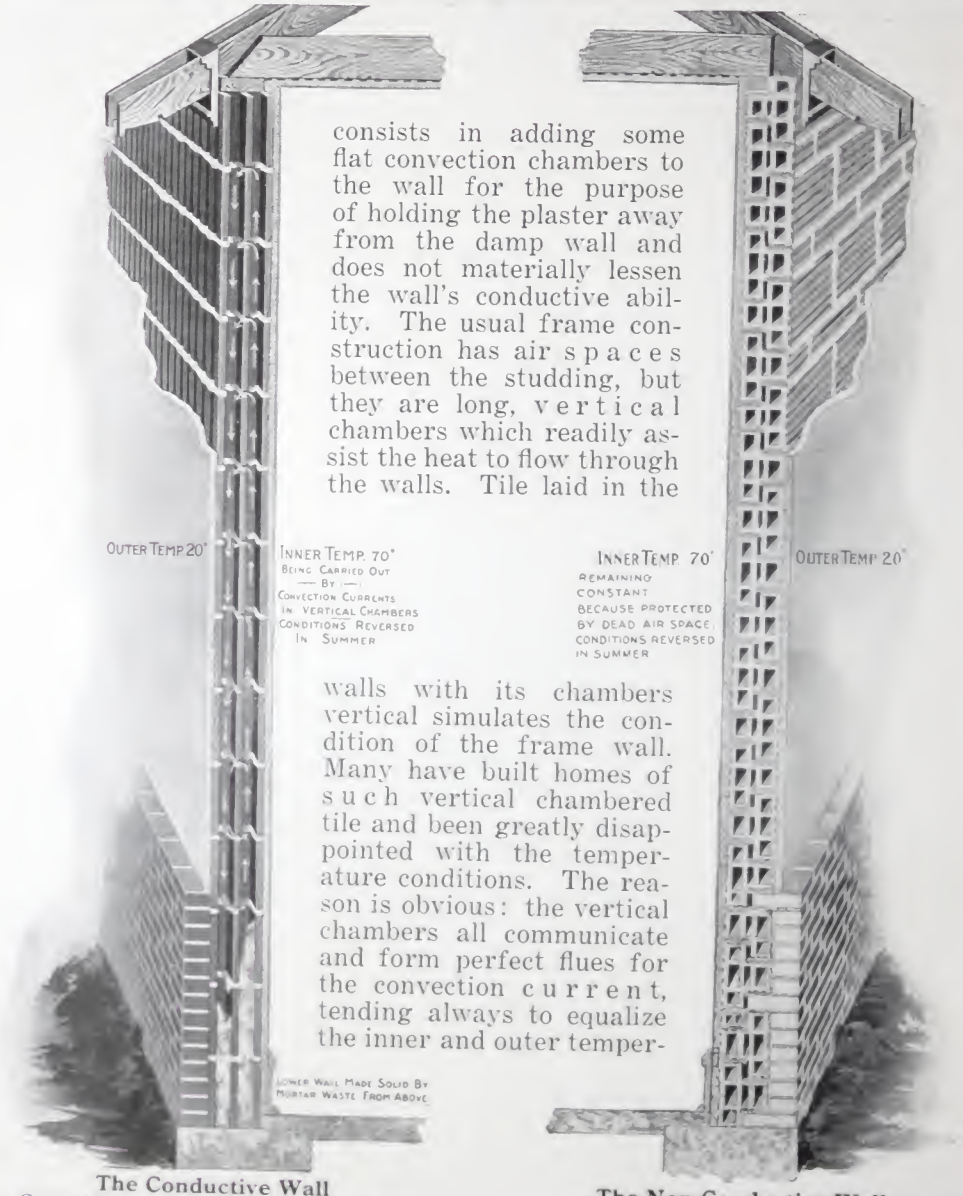
SUMMARY: A non-conductive wall must be built of some dense material like hard burned clay, and must contain horizontal non-communicating dead air spaces. A non-conductive wall results in a winter warmth with little fuel and a summer coolness with much comfort.

APPLICATION: A solid brick, concrete or stone wall may be much stronger than needed but it cannot be non-conductive. True, it may take such a wall a long time to heat through, but it keeps throwing out heat just as long after the temperature has decreased, hence the condition so often found in public buildings which will be insufferably hot on a cool day following a hot spell. Such solid walls are usually "furred" inside which usually

A Primer of Good Building--Lesson II

consists in adding some flat convection chambers to the wall for the purpose of holding the plaster away from the damp wall and does not materially lessen the wall's conductive ability. The usual frame construction has air spaces between the studding, but they are long, vertical chambers which readily assist the heat to flow through the walls. Tile laid in the

walls with its chambers vertical simulates the condition of the frame wall. Many have built homes of such vertical chambered tile and been greatly disappointed with the temperature conditions. The reason is obvious: the vertical chambers all communicate and form perfect flues for the convection current, tending always to equalize the inner and outer temper-



The Conductive Wall
Current Constantly Tending to Equalize Inner and Outer Temperature

The Non-Conductive Wall
Dead Air Space Maintaining Constant Inner Temperature

ature. Such a wall is always cold to the touch in winter. The inventor of DENISON TILE had just these principles in mind and set out with the distinctly formulated thesis that an outer wall must protect the occupants from the extremes of outside temperature.

If these principles are comprehended by the reader it will be obvious that DENISON INTERLOCKING TILE builds a non-conductive wall. If it is not apparent the test, here illustrated, made by the Building Commissioners of Cleveland, Ohio, should be proof. The temperature of 2,000° was obtained within these twelve-inch walls, while the outer surface failed to show a raise of one degree of temperature.

Conduction Test on Denison Tile Walls. Interior Face of Wall 2000°, Exterior Cold

DRY WALLS

TEXT: Walls should at no time be damper than the air of the room.

There are two ways by which the inside surface of the wall is made damp.

1. The Absorption of Moisture from the Outside. In damp localities or during long continued damp seasons a wall built solidly of porous material is sure to absorb enough water to permeate the wall and transmit the dampness to the interior surface. To prevent this such walls must be furred or built out on the inside to leave an air chamber. The same condition exists where there are mortar joints extending directly through the walls. Mortar joints usually have sufficient roughness of outer surface to detain moisture for absorption and thus transmit it in streaks to the inner plaster or decorated surface. In order to prevent absorption of moisture, the wall should be built of impervious material like hard burned clay, its mortar joints should not only be broken so as not to extend directly through the wall, but each mortar joint should be intercepted by a dead air space. While a few walls are damp on account of absorption the common cause of damp walls is the sweating of the wall.

2. The Sweating of Walls or the condensation of moisture from the atmosphere upon the inner surface of the walls is a common fault of most walls. The principle of condensation is best seen on a glass of ice water: The outer surface of the glass is made so much colder than the surrounding atmosphere that the moisture from the air condenses and is deposited upon the sides of the glass. This same condition is duplicated in the case of every conductive wall when the outside temperature is cooler than the inside. The result is that whenever the humidity in the room is increased for any reason the inner surface of the wall becomes damp. If the plaster surface is calcimined it looks mottled, and when the moisture is sufficient, to cause the

The cold glass has condensed moisture from the surrounding air.

running of the color. If the wall is papered the immediate effect is not so apparent but the paper soon becomes loosened. Few forms of decoration remain long permanent upon a wall subject to sweating and the wall itself is constantly weakened by such dampness. Damp walls mean poor sanitary conditions unhealthful for all inmates except germs which will prosper under such conditions.

If it were possible to build a wall so that its inner surface would always be at exactly the same temperature as the room there would never be any danger of such a wall sweating but such a wall is necessarily a non-conductive wall with its inner surface entirely insolated from its outer.

SUMMARY: Any impervious non-conductive wall whose inner surface readily assumes the temperature of the room will be a dry wall.

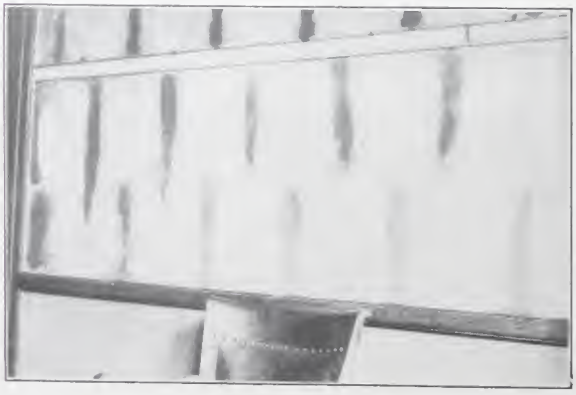
APPLICATION: In past years whenever walls were made strong they were damp because to the builders of those days strength and solidity were synonymous. Cathedrals, castles, and prisons were of solid masonry with damp, musty interiors. They did not realize the possibility of constructing walls at the same time both strong and dry. The chief virtue of the timber construction was that it was much drier than the solid masonry construction but strength was sacrificed to comfort. The next step was to combine the solid masonry walls with the timber walls by furring the solid wall but with such construction the outer wall was damp, the rooms were damp though the wall furring dried out rapidly. It is only very modern minds, making a study of these conditions who have found it possible and feasible to combine conditions of strength, non-conductivity and dryness in the same wall, and the idea is yet too new to have been thoroughly comprehended by the average man.

A concrete basement wall which has absorbed and condensed sufficient moisture to loosen the plaster.

A Primer of Good Building--Lesson III

A solid concrete wall where condensation has been sufficient to remove oil painted frieze and drip on to the lower walls.

A brief comparison of wall values will aid such comprehension. The chief virtue of the usual frame wall is that it dries out rapidly. It does sweat whenever there is excessive humidity because the large communicating air chamber within conveys the temperature of the outer wall shell to the inner but the outer wooden shell drying out rapidly the convection currents thus aid in drying the inner surface. Solid concrete, brick or stone walls may be so built that they will not absorb sufficient moisture to affect the inner surface but they cannot be so constructed but that the inner surface receives its temperature more directly from the outside than the inside temperature and hence during cold weather such walls are like the sides of the glass of ice water, condensing the moisture from the atmosphere of the room. Walls built of vertical chambered tile will always be dry when the outside temperature is higher than that within because of the free convection currents throughout the wall which heat the inner shell to the same temperature as the outer and keep the wall, in summer warmer than the room but during the humid seasons of spring, fall and winter when the outer temperature is low such walls will be colder than the room and will sweat. The only wall which will be dry all the time is a wall whose inner surface immediately assumes the temperature of the room regardless of the temperature of its outer surface. This means that the wall must get



A vertical chambered tile wall where the through joints are so thick and solid as to form evident condensation streaks.

its temperature from the room and not from any form of transmission through the wall. In a Denison Tile wall the inner shell is so insolated from the outer, by means of the intervening dead air spaces, that the inner surface must be at the same temperature as the room and hence it has no power of condensing moisture. The interlocking joint not only intervenes air spaces between its exterior and interior exposures, but the joint itself runs into an air chamber which effectually stops any moisture which might get through the outer half of the joint. So far as yet invented the Denison Tile wall is the only wall which effectually combines the conditions of strength, non-conductivity and dryness.

It is customary for architects and building codes to require that clay materials of which walls are constructed shall have an absorption of less than twelve percent although they allow the use of concrete and lumber with a very much higher percentage of absorption. However the percentage of absorption is generally a good measurement of the strength of clay materials. The higher the absorption the more porous is the clay body and hence the less its strength. Denison Tile as manufactured always has an absorption of less than ten percent.

Except in foundations and other underground walls there is very little danger of moisture permeating the walls by absorption. Inner dampness is universally the result of condensation which no amount of waterproof coating will prevent. The cheapest and best insurance against damp walls is to build them of Denison Interlocking Tile with its horizontal intervening dead air spaces, broken joints and non-absorptive body, incorporating all non-conductive and strength giving features.

Building the only surely dry wall—of Denison Interlocking Tile.

FIREPROOF WALLS

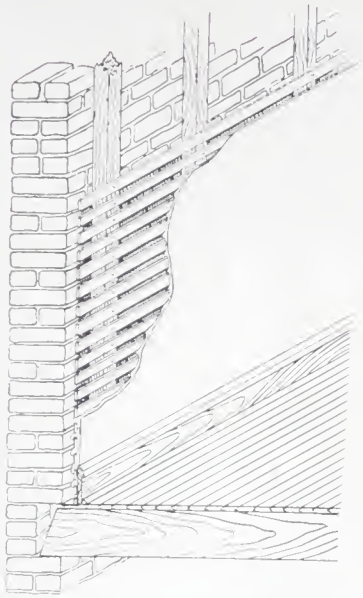
TEXT: All that is non-flammable is not fireproof.

In order to be fireproof there are five elements which a wall must possess:

1. It Must Be Built of Non-Combustible Material. Though there are ways of "fireproofing" inflammable material the product at best is but a slow burning substance which at high temperatures becomes combustible. Though there are ways of building "slow burning construction" from combustible materials such construction fails to stand the test at the crucial time and is expensive. The only strictly fireproof materials are those inorganic substances which have stood the test of the earth's fires of ages, such as stone, asbestos, iron and clay.

2. It Must Not Disintegrate at High Temperature. Not all these inorganic substances are fireproof. Some of the building stone; a great deal of the concrete, as it is now being installed, will disintegrate at fire temperatures, sufficiently to make unstable walls. In general building materials made up of small particles and associated by means of solution instead of heat, such as soft sandstone, gypsum blocks and pressed cement blocks will crumble at comparatively low temperatures. Properly mixed and poured concrete is an exception to this rule. Much of the clay material being used is not fireproof, manufactured of friable clays, soft burned at temperatures of from 800 to 1400 degrees, the brick or tile will become chalky and crumble during a fire. To be fireproof, clay should be hard burned, which is simply duplicating the earth's process of rock making. Hard burned clay makes a fireproof material. A wall built of fireproof components may itself lack this quality because of the method of joining. For example, the average mortar joint is subject to disintegration during conflagration and leaves an unstable wall.

3. It Must Not Require Any Furring or other inflammable parts to make it a complete wall. The ordinary studded furring makes a fire trap of an otherwise noncombustible wall. Not only because the furring itself is inflammable, but because the vertical air spaces thus formed make ideal flues. Such furring flues lead below and above to the most vulnerable parts of the building; where the floors and roofs bear on the wall. A fire originating above drops sparks through these spaces to ignite the floor below. A fire originating below finds an ideal draught flue through these furring spaces, sweeping the flames to the floors and roof above.



The ordinary furred brick wall showing the fire flues back of the plaster leading to the floors

4. It Must Not Have Vertical Air Spaces within the wall which will form flues for the transmission of flames or sparks up or down the wall. Walls built of vertical chambered tile, "hollow block" and cement blocks form flues which have the same destructive influence as the furring space above described.

5. It Must Be Sufficiently Non-Conductive to protect materials on the other side of the wall. A wall itself may withstand injury from fire but if it conducts heat through the wall sufficiently to ignite inflammable materials on the other side it is not a reliable "fire wall." The more nonconductive a wall can be made the better firewall it will make. Hence all the principles taught in Lesson II are directly applicable to fireproof construction.

SUMMARY: A fireproof wall must stand strong after a fire and must have protected adjacent structures and furnishings.

APPLICATION: No method of frame construction is sufficiently fireproof to warrant discussion here. A properly mixed, poured and set concrete wall, furred with horizontal tile should be thoroughly fireproof. But concrete work is so subject to careless construction, failures have been so numerous and the cost is so excessive as to make its use questionable. Heavy brick walls are ordinarily considered fireproof and so far as being

noncombustible they are. Their weakness lies in the mortar joints. Everyone is familiar with the appearance of a brick wall after a severe fire; the bricks themselves may be sound, but great cracks follow the mortar joints and the bricks easily split off from the mortar. Why? The numerous and intercommunicating joints run directly through the wall unbroken by air spaces or any other insulation so that when a crack starts in the heated surface there is nothing to prevent its extending through the wall. All the joints are flat with nothing but the bond to keep the bricks from sliding. There is absolutely no guard against side thrusts. Practically all the force on a wall during a conflagration is a side thrust: the heated side of the wall must rapidly expand, there being no air chambers in a brick wall to take care of this expansion, the wall must buckle, the mortar bond readily gives way and every stress and strain finds an accommodating mortar joint for a crack. The great fire weakness of a vertical chambered tile wall arises from the facts: (1) that its vertical flues make it a perfect conductor of heat not only through the wall but throughout the structure; (2) its mortar joints, always weak and toply on account of insufficient bedding and their direct extension through the wall, do not at all withstand the side thrusts imposed during fire; (3) the surface faces of the tile are their main supporting strength, the crosswebs adding nothing as shown in Lesson I. When the heat rapidly expands the surface of the tile it is apt to check and crack and its supporting strength is at once removed.

The bricks withstood the heat, but the mortar joints cracked, making the walls unsafe

A DENISON TILE wall is more nearly fireproof than any other practical wall for six or more reasons: (1) The tile being hard-burned, is noncombustible and will not crumble at high temperatures. (2) Its main supporting strength is derived from its internal vertical webs, continuous from

footing to roof, the surface face contributing so small a proportion that if it should check, sufficient wall strength remains; (3) The interlocking of the tile so arranges that there are no through joints. The tile is designed to safely withstand all the extra side thrusts which are added by fire expansion. (4) All mortar joints dove-tail into the tile itself so there can be no slipping or sliding of the tile, nor loosening from the mortar. (5) As a further precaution the majority of mortar joints do not reach the fire surface at all and are protected from the heat by intervening dead air spaces. (6) The non-conductivity of the tile as shown in Lesson II makes it a perfect fire wall. The horizontal air spaces confine the effect of the heat to the exposed surface of the wall, absolutely insulating the internal webs and outer surface from the effects of the heat. It would seem that this unequal expansion of surface face would cause it to crack off but experience has proven this is not the case. This is partly accounted for by the fact that the arrangement of the air cells is such as to accommodate the expansion.

The fire in the Hotel Statler, Cleveland* gives a typical comparison of heat resisting qualities. The supporting steel beams were covered with semi-porous fireproofing, they crumbled almost completely away. The room partitions were of Gypsum blocks which became so chalky they disintegrated entirely and became sediment in the firewater. The outer walls were of *Denison Tile* and affidavits of architect and builder state that not even the exposed surface of a single tile was checked or cracked. These same results have been produced in similar cases and by artificial tests.

These are the reasons Denison Tile is being so extensively used for special purposes where such qualities are required; for lumber dry-kilns, saw-dust burners, powder houses, and boiler walls.

What would be the pleasure of safety in a reasonably fireproof house with no cause to worry on account of neglected furnace draughts, crossed electric wires, or lightning storms?

*(See next page)

Starting to build a really fire proof residence of Denison Interlocking Tile

A Primer of Good Building--Lesson IV

"XX" shows where gypsum partition joined the Denison Tile wall when the fire began. The column at the left was also covered with another fireproof material which the fire destroyed.

The Test That Tells

"I hereby certify that the Denison Tile used in backing up the outside walls of the room in The Hotel Statler, where a severe fire occurred during construction, occasioned by the burning of a quantity of filled gasoline torches, were left absolutely undamaged and are entirely free from spalls and checks, notwithstanding the fact that they were exposed to the most severe heat of the conflagration. The intensity of the heat was evidenced by the destruction of the other fireproofing materials covering columns and beams adjacent to the Denison Tile."

(Signed) REESE LINDSAY, Supt. of Const. Asst. to Mr. John B. Day, Supervising Architect for Geo. B. Post & Sons, Architects.

FOUNDATION WALLS

TEXT: Upon the foundations depends the house; for endurance; for dryness; for sanitation.

To be a satisfactory foundation wall it should possess five characteristics.

1. It Must Have the Strength to support the superstructure under all conditions of strain and pressure. The bearing pressure of any structure upon its foundation, with all added loads and pressures is very readily figured by architects and engineers. The actual bearing strength of the material of which the foundation is to be built may be determined by engineering tests. The wall component should not only be able to bear all the theoretical weight of the loaded structure but five times this pressure as a factor of safety.

A Denison Interlocking Tile Basement. The upper wall is started at the right, continuous with the foundation.

2. It Must Have a Wide Bearing Surface for the Superstructure. Regardless of the bearing strength it is never safe to support a structure on a narrow foundation wall. Winter freezing pressures against the foundation, slight settlement and shifting of superstructure, wide floor bearings and other permanent and emergency considerations demand a twelve-inch foundation wall of any material as the minimum even under a one story bungalow.

3. It Should Be Continuous with the Superstructure. In the average house construction the weakest point is the line between foundation and superstructure. This is evidenced at times of flood and wind destructions when houses are most easily moved off their foundations, being for the most part only laid on, or at the most, bolted to the foundations. This is not as it should be. The rigid foundation should transmit its stability to the superstructure through a perfectly continuous bond between the two.

4. It Must Prevent Seepage of Water through the foundation. The supreme test comes during the spring thaws when the frozen soil is impervious, has cracked away from the foundation and leaves a flood of water bearing against the foundation. Then if there are mortar joints running unbroken through the wall they will leak. Then unless the foundation material has an absorption under eighteen per cent it will leak. If the absorption is about twelve per cent it may not leak but will become a sponge absorbing and holding moisture to the detriment of its strength and the health of the occupants. To prevent seepage the foundation material should have an absorption under ten per cent and all mortar joints should be broken so as not to be continuous through the wall.

5. It Must Prevent Condensation of Moisture on the basement walls under extreme conditions of temperature and humidity. For there is no place where conditions which cause condensation are so extreme as in a basement during summer; the exposed water pipes sweat, the cellar air is charged with moisture, the soil against the foundation wall is cold. If the foundation wall is a solid conductive wall it will assume the cooler temperature of the earth without and condense the moisture from the air making a wet sweaty wall which retains its dampness in spite of ventilation and permeates the house with damp odors. If the foundation wall is non-conductive so that its inner surface readily accepts the temperature of the basement, it cannot sweat, the moisture remains in the air and by slight ventilation any damp air is readily swept out of the cellar.

SUMMARY: A foundation wall should have a test strength at least five times greater than required by dead and live loading of the superstructure, it should never be less than 12 inches thick, it should be built of the same material as the superstructure and continuous with it. It should be non-absorptive with no through mortar joints. It must be non-conductive.

APPLICATION: In order to get an idea of the weight of a structure on its foundations we will imagine an extreme case: a three story building and basement of heaviest fireproof floor construction with full twenty foot span, with walls of Denison Interlocking Tile as shown in the diagram. Find the weight on the first basement course of tile:

The A B C of Good Construction--Lesson V

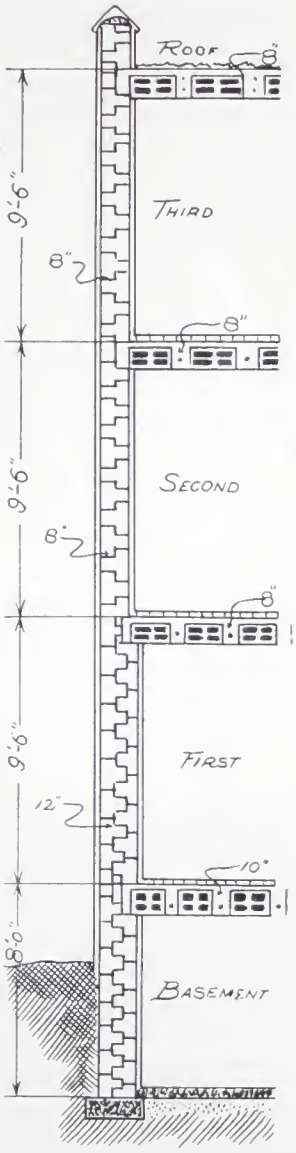
WEIGHT OF WALLS

	Built of	Height		Weight per Surface Ft.		
Basement..	12″ Denison Tile	8′ 0″	×	60 lbs.	=	480 lbs.
1st Floor...	12″ Denison Tile	9′ 6″	×	60 lbs.	=	570 lbs.
2d Floor...	8″ Denison Tile	9′ 6″	×	50 lbs.	=	475 lbs.
3d Floor...	8″ Denison Tile	9′ 6″	×	50 lbs.	=	475 lbs.
Total wall weight on each foot at base.....						2000 lbs.

WEIGHT OF FLOORS AND LOAD

Built of	Dead load lbs.		Live load lbs.		½ span ft.		lbs.
1st Floor, 8″ tile 10″ concrete.....	100	+	50	×	10	=	1500
2nd Floor, 6″ tile 8″ concrete.....	85	+	40	×	10	=	1250
3rd Floor, 6″ tile 8″ concrete.....	85	+	40	×	10	=	1250
Roof, 6″ tile 8″ concrete.....	85	+	40	×	10	=	1250
Total floor weight on each foot at base.....						lbs.	5250
Total weight on each foot at base.....						lbs.	7250

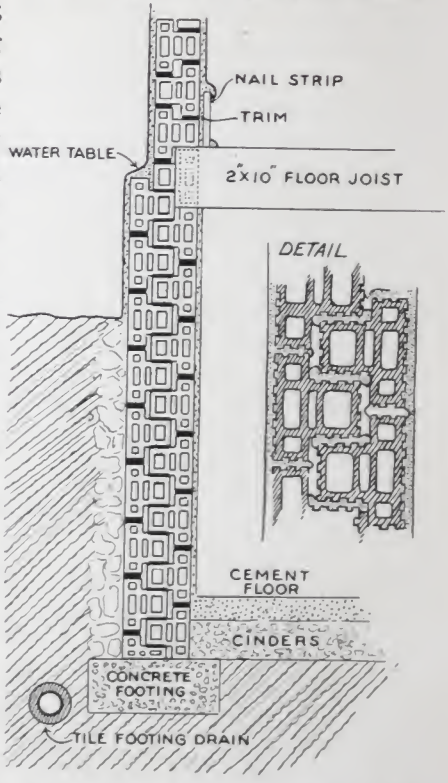
The base being a 12-inch wall this load is borne on 144 square inches or $\frac{7250}{144}$ = 50.34 lbs. on each square inch. Figuring a factor of safety of five times the actual weight, any material at the foundation base should support 251.7 pounds per square inch. The lowest engineering test made on Denison Interlocking Tile was one made by The Robert W. Hunt & Company and showed that Denison Interlocking Tile would support 700 pounds per square inch of surface, (the U. S. Government test showed 1367 lbs.) or that Denison Interlocking Tile in this building at the base of the 12-inch foundation has a factor of safety of $\frac{700}{50.34}$ or 13.9 practically a factor of safety of 14 times the actual pressure.* In such a building as this the architect would ordinarily figure a 16-inch brick or concrete foundation. The reason for the great supporting strength of Denison Interlocking Tile is the fact that all webs of the tile align vertically, thus transmitting to the wall every particle of strength in the individual tile. It further guards against side strains because the interlocking joint catches such strains and transforms them into direct downward pressure.



*If the weight were figured against the actual supporting web section the factor of safety would be 16.3. According to the U. S. Government test of the tile this factor of safety would be 100.1.

A Primer of Good Building--Lesson V

Denison Interlocking Tile is universally made of the best material and never shows an absorption of over 10%. Absorption tests by Robert W. Hunt & Company show an absorption under 1%. The average is between 3% and 5%. This means that the tile is much denser than any surrounding soil medium even when frozen; that there is no possibility of absorption of moisture even sufficient to dampen the surface shell; that any outside waterproofing or plastering of the Denison Interlocking Tile basement wall is useless and superfluous. In comparison a solid concrete wall is a sponge. The usual concrete foundation has an absorption of 15% or over; its interstices are full of water half the year; it seeps to the inner surface, finally cracking to an open leak. A brick basement wall is usually dryer than the concrete but the numerous through mortar joints of the brick wall allow ready seepage at wet seasons and retain dampness through the year. The 12-inch Denison Interlocking Tile wall has no through joints, either horizontally or vertically. Suppose one of the outer mortar joints in the accompanying diagram were faulty and allowed seepage; trace the course of the water thus let in and note the impossibility of its getting through the wall. The vertical joints are just as well broken, every joint is interrupted by a void in the joint and not less than a four-inch wall beyond containing dead air spaces. A Denison Interlocking Tile basement wall is absolute insurance against seepage and it is the only wall which offers such protection.



All that has been said in previous lessons concerning nonconductivity of Denison Interlocking Tile walls is true of a foundation and is of much more consequence than in superstructure walls. The inner shell of the Denison Interlocking Tile wall is so insulated from the outer that the inner shell will readily assume the temperature of the basement air irrespective of the temperature of the outer shell or the soil against it. Hence the wall cannot sweat and the basement is

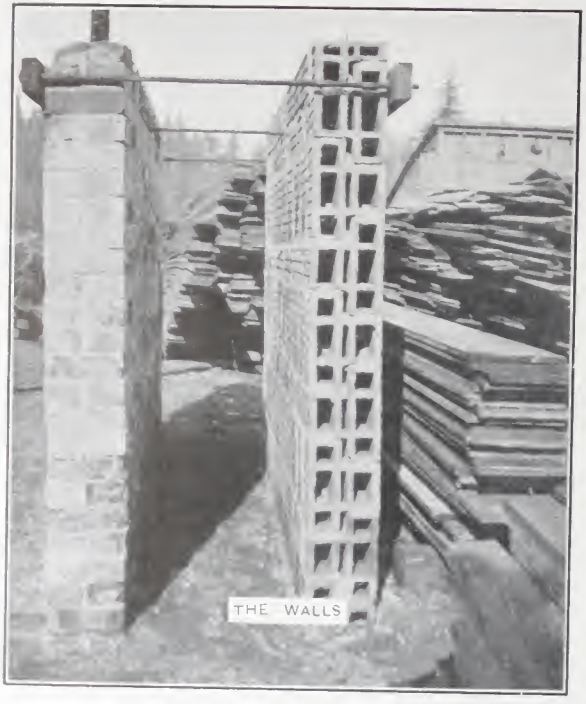
The superstructure and sides of steps are built of tile on a concrete foundation. Note the difference in the absorption of water.

kept dry and sweet by a little ventilation. Concrete or solid brick foundation walls are so much colder in summer than the air that they always condense the moisture from the air on their inner surface and no amount of ventilation will keep the cellar dry.

A building of Denison Interlocking Tile from footing to roof sill has no weak line in the walls. The wall is continuous from foundation to superstructure with the tremendous strength of the interlocking joints giving all the rigidity of the foundation to the upper wall. This cannot be true above concrete foundations unless the superstructure is poured continuous with the foundation. This is not true of any material which builds with a through horizontal joint.

CONCLUSION: Vertical chambered tile are out of the question for foundations; their narrow web bedding makes too weak a wall to withstand the varying earth pressure; the through joints leak; the vertical flues permit convection currents and aid sweating. If such tiles are laid flat, through joints are left with no possibility of making the vertical joint anything but a leaky line. Concrete foundations may be waterproofed to prevent seepage but they are sweaty walls which keep damp, eventually crack and leak and are never more than a stool upon which the superstructure sits held by its own weight. Brick foundations have all the faults of concrete except that they may afford more continuity with the upper walls. And they are all considerably more expensive than the Denison Interlocking Tile wall which affords a strong foundation, a dry basement and the strongest union between foundation and superstructure.

Starting a Denison Interlocking Tile foundation. Note the ease with which the mason handles tile equal in volume to ten brick. The illustration shows the intercepting of both vertical and horizontal joints.



The Two Walls Just Before Applying the Test.

The Jack in Place R for

A Few More Turns and the Brick Wall is Ready to Fall.

THE T

Denison Interloc ng T More Stable Tha Solid

WALLS same ckne up at same me— used—(1 c nt, lime putty). Wal ood before testing.

for Screwing up.

A Few Turns on the Jack Starts the Break in the Brick Wall.

EST

Tile Walls are lid Brick Walls

hness (8"). Laid e—same mortar t, 3 sand, 10% od three months

The Result—the Tile Wall Stands as at the Start of the Test and Showing no Effects of the Strain.

THE WALL AND FLOOR JOINT

TEXT: Let the walls so provide for the floors that they may be mutually strengthening.

In order that the floors may be a solid and firm part of the structure the walls must provide the following conditions:

1. A Firm and Level Bedding for the floor supports. If joists are used they should have a wall bearing of not less than four inches. The bearing should be flat to support all of the adjacent joist surfaces. Care should be exercised to see that the form of construction is such that the burden of every joist end is stiffly supported on this bearing not only at the point of rest but from the footing to this point sufficient to take care of emergency floor loads. Even in the most ordinary house construction each joist end should be figured as bearing upon the wall with a weight of not less than 1500 pounds.

2. A Strong Grasp of the Floor Supports to hold them in a firm upright position. It is often possible in structures with masonry walls, where the joists are not tied firmly into the wall, to set up a swaying weaving motion in the floor. This may be prevented by using a wall construction which naturally provides for the insertion of the joists into the masonry wall and the masonry fitting tightly about the joist ends.

3. The Bearing Wall Should Continue Unbroken and Unweakened by the floor intrusions. In many forms of masonry walls the construction is a unit until it reaches a floor bearing but at this joining the wall becomes a patchwork affair, leaving a weak place where lateral pressures are apt to bulge the wall. In an attempt to prevent this weakness the joists are often hung on iron brackets extending out from the wall resulting in insufficient and badly exposed floor bearings. The only prevention for such weaknesses is to be assured that the wall continues as a unit through the line of floor joining.

Continuing a Denison Tile wall uninterrupted above the floor joint

4. The Bearing Wall Should Be Designed to Withstand the Side Thrusts of the floor as well as the downward pressure.

Such lateral pressures might be taken care of either by avoiding any horizontal through joints in such a way that side pressures will be transmitted to lower courses or by building a wall having through joints much thicker than would otherwise be required. Whenever lateral pressure is applied above a through joint the tendency is for the upper course to topple on the lower one and break away from the joint.

SUMMARY: The joining of the floor with the bearing wall should be a mutually supporting joint so constructed that the wall will not be weakened either by lack of continuity in itself or by the lateral pressure of the floor.

APPLICATION: The present floor construction with wood joists into masonry walls is an adaptation from frame construction where the joists and studding were firmly nailed together and made mutually supporting against lateral pressures. It is most important that any form of building must accomplish this same result and be strengthened against side thrusts. Brick walls are notoriously weak in this regard. The thrust of the floor is prone to displace the brick from their plane mortar beds and cause them to slide or topple outwards. Attempts to remedy damage so caused are apparent on many brick buildings in every locality where tie rods, wall clamps and extemporized bracings have been inserted through the bulging walls to prevent disaster.

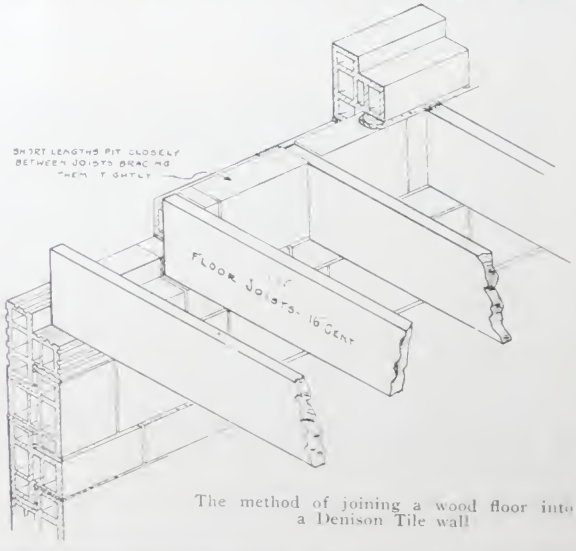
In concrete walls it is customary to pour them to floor heights and after building the floor to pour the next section, thus leaving a poorly bonded line at the floor joint just at the place where the walls should be strengthened.

In building with vertical chambered tile it is necessary at the floor bearings to change the usual wall

A brick wall held together against the floor thrusts by means of bolts and braces

construction and build in with bearing and filling tile. This makes a patched line across the building, all with through joints having even a greater tendency to give way to lateral pressure than a brick wall because of the insufficient mortar beds on the webs of the tile.

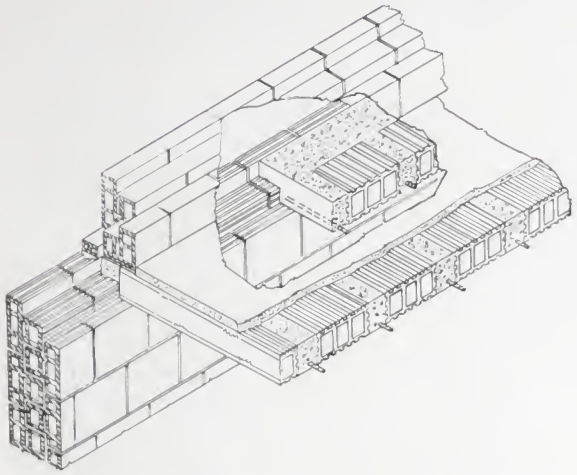
Denison Interlocking Tile builds a wall with no through joints and is especially designed to resist lateral pressures. A force coming against the side of any course of Denison Tile is caught by the interlocking lugs and transmitted to the courses below as a resultant downward force. For this reason the comparative tests always show a greater resistance to any lateral pressures by a Denison Tile than by a brick wall. For this reason there is no wall which shows a greater strength at the floor joints than a Denison Tile Wall. The construction of a Denison Tile wall is continuous from footing to roof, there is no break at the floor joints, the tile fit snugly between the joists, holding them firmly in an upright position. Each joist end has a full bearing seat of over four inches supported by two vertical webs, thus bearing on 2.8 square inches of vertical web section. According to the minimum tests each square inch of vertical web section will support 2964 pounds. Each joist end is then supported to the extent of 8300 pounds, a much greater weight than any two inch joist should be allowed to hold.



The method of joining a wood floor into a Denison Tile wall

A complete wall section of Denison Tile showing uninterrupted structure at floor joints.

The A B C of Good Construction--Lesson VI



A combination tile and concrete floor showing how thoroughly it bonds with a Denison Tile wall

The ideal floor for masonry walls is the combination tile and concrete floor because if properly constructed the wall and floor then become mutually supporting. The Denison Tile wall is especially adapted to receiving such a fireproof floor without any special provision. The tile and reinforcement rest on a solid bearing and the concrete flushes fully into the dovetail grooves of the wall tile, making a mutually supporting joint.

The Fire Hazard of the Furred Wall

THE WALL AND ROOF JOINT

TEXT: The outward thrust of the roof is a perilous thing to otherwise good walls

This was not a fire but a preventable catastrophe. The roof thrust displaced the top courses of brick resulting in the uncompleted roof falling in and carrying the floors and walls with it

In joining the roof to the walls the following conditions should be minded:

1. The Resultant Force of Roof Pressure is an Outward Thrust on the bearing walls. Regardless of the roof design and however much this lateral thrust may be guarded against by means of cross-ties, stringers, etc., the preponderance of strain on the walls is tending to spread them. This side thrust is tremendously increased by wind pressure and other emergency loads.

2. The Bearing Wall Should be so Designed that the Outward Thrust will be Transmitted to a Downward Pressure on the Wall. In timber construction this is accomplished through the nailing of cross ties, floor joists, etc., into the members of the bearing wall in a manner impossible in masonry walls. In most masonry walls the top courses have to stand all of the outward roof pressure. The tendency is for the units of this bearing course to either topple outward and break away from their mortar joints or to slue on the mortar bed. Unless some provision is made in the

masonry units to prevent both of these tendencies some safe provision should be planned for in the construction of the wall itself.

3. The Roof Sheathing and the Outer Wall Should Meet Intimately. It should be possible to continue the masonry of the bearing wall uninterruptedly between the rafters to make a tight joint under the sheathing. In most masonry buildings this joining shows shiftless work leaving noticeable openings, largely because the masonry units are not so made as to conveniently allow of closing the space.

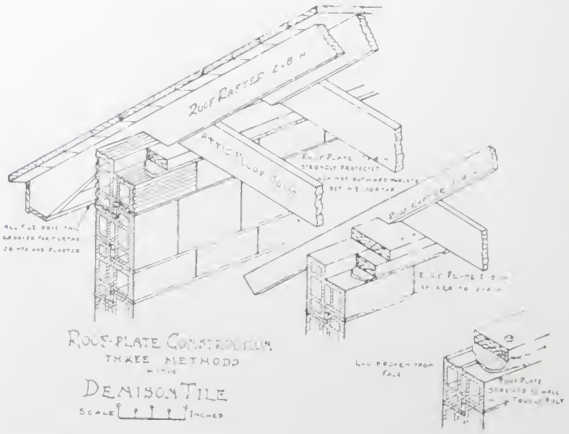
SUMMARY: The components of the wall should be so designed as to resist the tendency to topple from or slue on the mortar joint upon receiving the roof pressure but rather to transmit the lateral thrust to lower courses as a downward pressure and allow a firm attachment of the roof plates.

APPLICATION: The weakness of brick at the roof joint is due to the fact that the flat surfaces of the brick are in no way keyed to their mortar beds and the tendency is for the brick to break the slight bond and slue on the mortar bed with disastrous results. Every roof built on a brick wall should, by means of some attached member, be carried into the wall not five or ten courses, but five and ten feet, depending on the roof area.

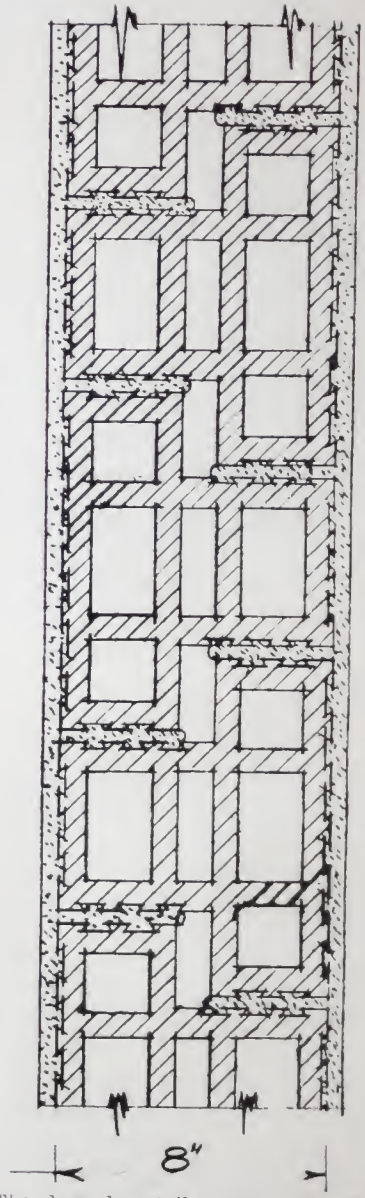
Mortar joints are the weak lines in masonry walls. Where the mortar joint, between rectangular masonry units, extends through the wall in one plane there is too little resistance against lateral pressures. The side thrust is not carried beyond this vertical plane into the wall below and hence gradually dissipated into a downward pressure but the mortar bond gives way, cracking in the horizontal plane. In some masonry units this tendency is often prevented in some measure by strengthening the mortar bond either by roughening the surface of the unit or making dove-tail grooves in the unit to receive the mortar as a mortise joint.

Putting a roof on a Denison Tile House

Hollow tile laid vertically, web over web, is exceedingly weak in this respect. There is so little resistance in the mortar joint that invariably the first sign of depreciation in a vertical chambered wall is the horizontal wall cracks below the roof bearing and at the wall and floor joints. Certain recent building codes have prohibited such construction unless screening is inserted between the ends of the tile to allow a firm mortar bed. Denison Interlocking Tile is especially designed to resist such lateral pressures as roof thrusts as more fully shown in Lessons I and VI. Reviewing briefly these efficient guards are: first, the deep dovetail grooves provided for every mortar bed making a mortise joint, not alone increasing the amount of surface for the physical bond but perfecting a mechanical



Roof Plate construction with Denison Tile



The deep dove-tail grooves and the interlocking joints resist great lateral pressures

Sill bolts applied in Denison Tile Wall to Hold Stone Coping

bond as well, which absolutely prevents sluing, and, second, the interlocking joint which provides laterally resisting lugs which on the cantilever principle, transmit lateral forces to become direct downward pressures.

On account of these features Denison Tile allows a further advantage in roof construction, viz., the simple and efficient attachment of the roof plates without the necessity of long sill bolts. The lug of the bearing course allows the convenient fitting of a two-by-four plate which receives the outward roof thrusts directly against the resisting lug of the tile. Where it is desired to make special provision against roof raising the horizontal chambers of the tile allow of the plates being securely fastened by means of toggle bolts. This method allows the rapid completion of the wall to the roof bearing without the necessity of stopping off the masonry to insert sill bolts. This, however, may be done with Denison Tile as conveniently as with any other masonry unit if desired.

After the roof rafters are in place and ready for the sheathing Denison Tile may be continued between the rafters close to the sheathing with the same convenience as shown at the floor joints and a mortar course effectually closes up all space between the wall and sheathing.

Denison Tile laid tightly to the Roof Sheathing

A Primer of Good Building--Lesson VIII

WALL OPENINGS

TEXT: It sufficeth not to build good walls and be slovenly about the openings therein.

A splendid example of the use of Interlocking Tile about openings

In order that walls may be substantial and fit closely to window and door frames the following conditions should be realized:

1. The Strength of the Jambs or Sides of the openings must be sufficient to take care of the extra weight thrown upon them by the arching of the strains above the openings. Nearly all building materials are strong enough to bear this downward pressure but small flat blocks with smooth through joints are prone to slue on their mortar beds due to the unequal strains here imposed. Unsightly cracks are common about wall openings in brick walls for this reason.

A Denison Tile Lintel directly supporting a Floor.

2. The Strength of the Lintels above the openings must be sufficient to carry the whole load imposed without deflection and be of a material not subject to depreciation. Wood lintels should not be used to support masonry walls for their life is short in comparison. Solid concrete lintels show damp streaks of condensation within.

3. The Wall Must Reveal the Frames on all sides in such a manner as to make air tight joints even after the shrinkage natural to the wooden frames. It is not unusual to feel the chill wind come in around the window and door casings. Often the dust streaks are visible on the plaster indicative of faulty joint construction. This is quite generally true of frame construction and too often of masonry walls not especially designed against it.

A Denison Tile Window Opening with the frame left out to show the Jamb Reveal and Sill Construction.

4. Provision Must be Made for the Addition of Decorative Features of sills, captions, arches, etc., without interfering with the necessary practical construction. It is customary to feature the wall openings. Many building units are so inflexible as to make this impossible without interfering with good construction or considerably increasing the cost.

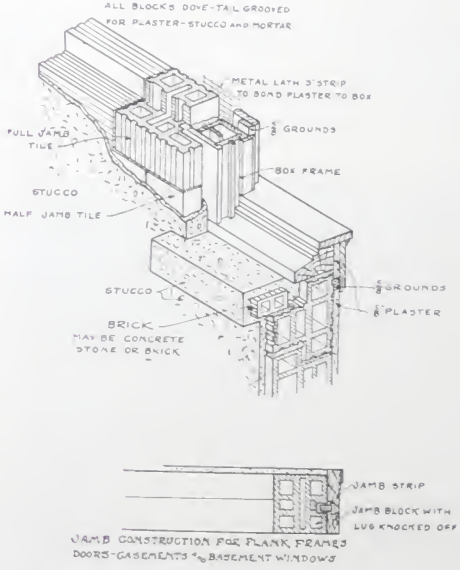
Denison Tile Lintels at a short corner

Denison Tile Lintels, Jambs and Sills in Simplest Application. Almost too good to cover with stucco.

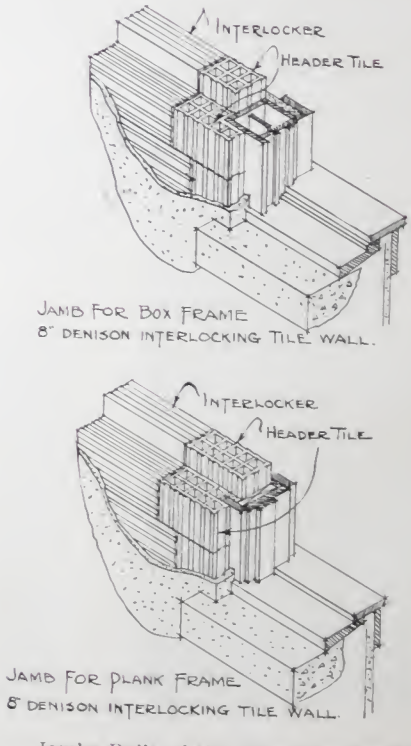
5. For Economy and Appearance the material of which the walls are composed should be adaptable to the proper building about openings.

SUMMARY: Acceptable building material should make walls which provide the additional strength necessary around openings and fit airtight about the frames without interfering with the freedom of decoration or greatly increasing the cost.

Denison Tile Lintels ready to set in place



Jambs built of Special Jamb Tile



Jambs Built of the Corner-header Tile

The A B C of Good Construction--Lesson VIII

APPLICATION: The flexibility of Denison Interlocking Tile is nowhere so well demonstrated as in its application to proper construction about wall openings. This adaptability was, of course, studied and designed. The Interlocking joint with its mortised mortar beds makes the ordinary Denison Tile wall superfluously strong to accept the added weight of the opening arch. It is inconceivable that Denison Tile can shift on their beds to either cause wall cracks about the openings or to press against the frames and pinch the sash.

Showing the application of Denison Tile in Porch Columns and Six Foot Span Lintels.

The Denison Tile Lintel is the simplest, cheapest, most practical and efficient lintel possible to design. It requires no special tile on the job, no delay for setting, and no interference with the regular mode of construction. It will efficiently support a span up to nine feet and is subject to no deflection. In one day one laborer can make all the lintels required on an ordinary residence. The tile are stood on end one above another to the required lintel length, reinforcing rods are dropped into two or more of the chambers, depending upon the length of the span, and the chambers poured full of cement mortar. After setting for from two to five days the lintels are ready to be lifted into place when desired. This lintel simply continues the coursing of the wall without interruption or special construction.

The Denison Header Tile used in Arch Construction

masonry units to prevent both of these tendencies some safe provision should be planned for in the construction of the wall itself.

3. The Roof Sheathing and the Outer Wall Should Meet Intimately. It should be possible to continue the masonry of the bearing wall uninterruptedly between the rafters to make a tight joint under the sheathing. In most masonry buildings this joining shows shiftless work leaving noticeable openings, largely because the masonry units are not so made as to conveniently allow of closing the space.

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Putting a roof on a Denison Tile House

STUCCO SURFACED WALLS

TEXT: External plaster endureth long and effectively in any clime when properly supported.

In order to permanently and efficiently retain a stucco coat the following precautions must be observed in building the wall backing:

1. It Must Not Expand or Shrink except in the same proportions and for the same causes as the stucco coats. Stucco is practically inexpansive being very slightly affected by heat and not at all by moisture. When applied to substances like wood lath, which expand upon absorption of the water from the plaster and shrink upon drying out, the stucco is left only loosely attached. The seasonal shrinkage and expanding results in stucco cracks, loosening and final disintegration.

This entire front is stucco on Denison Tile. It is a splendid example of the decorative possibilities of exterior plaster. The basement is stuccoed in imitation of cut stone.

2. It Must Not Disintegrate Under the Stucco. Even the best stucco cannot be depended upon to be entirely impervious to moisture and air. Any backing material, such as metal lath, which will disintegrate when exposed will in time give way under the stucco, its permanency depending upon the climatic conditions. In intermittently damp and dry regions, four or five years is sufficient for the disintegration of metal lath under exposed plaster to such an extent that only the rust streaks remain in the stucco.

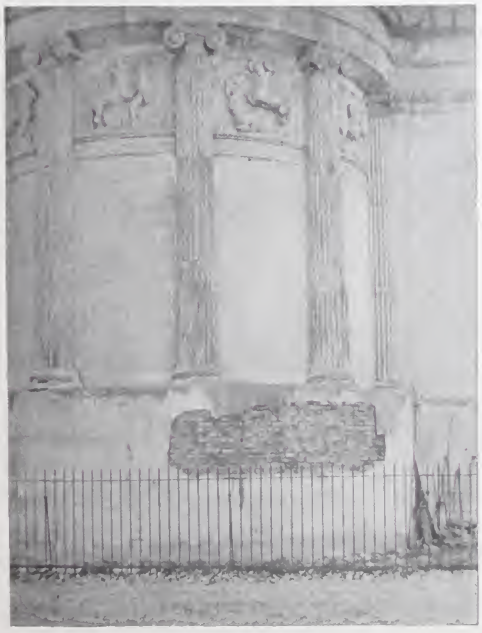
3. It Must Be Low in Absorption of Moisture. Cement mortar does not depend entirely upon tentacling to adhere to its backing as does lime mortar. When allowed to set properly, it forms a strong capillary bond between its body and an impervious surface which is even more adherent than the bond within the mortar itself. When stucco is applied to a highly absorptive surface like soft brick or concrete the surface extracts the water from the adjacent mortar preventing a proper set and leaving instead a thin layer of porous sand and cement next to the backing surface where the bond should be. This is one reason why stucco is not permanent upon porous brick, soft tile and concrete walls. It has been determined that for permanent stucco the backing should not have an absorption of over 12 per cent. The surface should be roughened or grooved to facilitate application by allowing a clinging surface for the wet plaster. These grooves should run horizontally, the better to resist gravity sliding.

A typical failure of stucco on wooden lath.

This stucco was applied on expanded metal lath over brick. The lath has rusted out and the whole surface is loose.

4. It Must Not Allow Moisture to Accumulate Behind the Stucco.
Solid masonry or any other walls which induce sweating are not fit for the application of stucco. The accumulation of a damp layer back of the plaster coat will very soon destroy the bond and cause the stucco to drop off above the damp surface.

An example of stucco on a concrete backing



A PORTION OF THE FIELD MUSEUM, CHICAGO
An example of what happens to stucco applied over common brick

5. It Must Not Contain Soluble Salts which will eventually permeate the stucco and appear in blotches on the exterior surface. Concrete is almost sure to contain such substances in abundance and stucco coats over concrete invariably have a blotched un-uniform appearance. Any clay material backing stucco should have been burned to a degree of heat sufficient to destroy all such soluble minerals. Precaution should also be taken that the mortar sand used in the wall does not contain soluble salts. Sea sand or lime mortar should never be used in a wall to be stuccoed.

6. The Exterior Wall Should Be Plumb and Surface Even. When stucco must be unevenly applied to even up the surface it will usually appear blotched and the extremely thick stucco easily loosened. Masonry units with insufficient mortar beds such as vertical chambered tile, require great care in keeping plumb and their use should be guarded carefully for stucco walls. It is much easier to even up with the plaster than to build the wall plumb unless the wall units naturally lay a plumb wall.

SUMMARY: The backing for permanent exterior stucco must have the same coefficient of expansion as the plaster, it must not disintegrate upon exposure, it must have an absorption under 12 per cent, it must not sweat, it must not contain soluble salts, it must be a plumb and even surface.

APPLICATION: External stucco finish has fallen into undeserved disrepute very largely because of its tendency to crack and fall off. These failures are due in some cases to improper mixtures and application but more often to the fact that the stucco is applied to wall backing quite unsuited to retain it. In habitually dry climates, stucco may permanently cover a multitude of sins but in regions with long damp and frosty seasons, stucco is itself a sin unless applied to a wall backing especially designed to meet all the requirements above enumerated. Denison Interlocking Tile builds a wall wholly adapted for stucco coating. On account of its Interlocking Joint and four inch mortar bed, it is almost impossible for a mason to build a wall out of plumb and with an uneven surface. The same strong bedding is responsible for the fact that the horizontal stucco cracks marking the wall joints never occur in Denison Tile walls. These familiar cracks, often outlining the

THE SCRATCH COAT APPLIED ON DENISON TILE

underlying wall tile are produced, especially in vertical tiled walls where the insufficient mortar bedding permits the tile to shift and tilt out of its original set due to slight settling of the structure or to floor and roof pressures. The numerous dead air spaces in the Denison Tile wall prevent any tendency to sweat and leave the outer shell so insulated from the inner that it accepts readily the temperature of the stucco surface thus expanding and contracting with it and eliminating one of the prevailing causes for cracks. Denison Interlocking Tile has an absorption considerably below the requirement, absorbing so small an amount of water from the scratch coat as to leave so permanent and so efficient a bond between the stucco and the tile that after the stucco has thoroughly set it cannot be cleaned off the tile without chiseling.

The softest of Denison Tile is burned to so high a temperature as to produce semi-vitrification at which point all soluble salts are driven from the clay body and the litmus paper test will show no reaction. A tile is thus formed which will not disintegrate under any weather conditions to which it can be subjected. The surfaces of soft or semi-porous tiles will often cleave off in their laminations when covered with only the slight protection the stucco affords against dampness and frost.

Denison Tile house before the stucco coat

Denison Tile house after the stucco coat

Due to its design Denison Tile affords horizontal plaster grooves which hold the scratch coat firmly in place against the tendency of wet plaster to sink away from that above, thus making the proper application of stucco much more sure than upon tiles having vertical surface grooves.

BRICK VENEERED WALLS

TEXT: Vanity! Vanity! Brick Veneer is all vanity unless the wall is so composed that the brick shall be an integral part of the supporting wall.

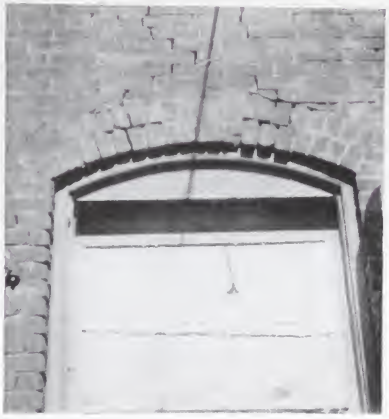
In order that brick veneer may fulfill other offices than mere external appearance there are three conditions which must be observed:

1. Brick Header Courses Must Extend Into and Become a Part of the Backing Wall. When four inches of face brick is simply laid up along the face of the backing wall, as is often done, the brick cannot aid in the support of the floor joists or roof. Such construction results in two separate walls of widely differing supporting strength. The four inch wall of brick is not of sufficient strength to support itself without the aid of the backing wall. Brick ties uniting the veneer to the backing wall at occasional points do little more than add to the burden of the backing wall and in no way assist the veneer to be a bearing member.

A Splendid Example of English Bond Header Construction over Interlocking Tile

2. The Backing Wall Must Be Composed of Practically Non-shrinkable and Non-absorptive Material. As the veneer depends for support upon the backing wall, if the backing wall shrinks away from the brick veneer, its tendency is to follow resulting in exterior cracks and bulges. If the backing wall swells or bulges the veneer is pushed out of plumb. Such weaknesses especially develop about windows, doors and at corners not only destroying the intended appearance but admitting moisture to the backing wall with disastrous results.

3. The Component Parts of the Backing Wall Should Be Designed to Accept Header Courses strongly held within them in such a way as to knit together both veneer and backing wall into one single bearing wall. Many materials acceptable in themselves for bearing walls can only be made to receive header courses by some makeshift which not only does not fully unite the walls but destroys the efficiency of the bearing wall.



Characteristic Appearance of the Usual Brick Veneer Construction after Weathering

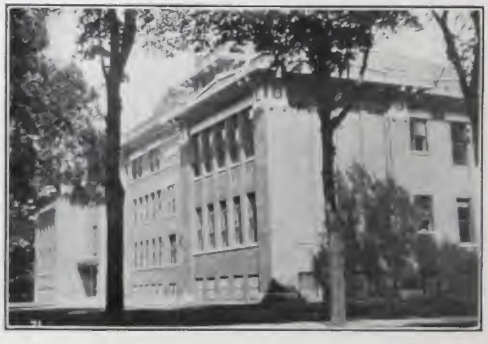
SUMMARY: To avoid rapid depreciation and give economical efficiency in brick faced walls, the backing wall should be built of component parts having approximately the same co-efficient of expansion and absorption as brick and be so designed as to naturally receive and hold firmly the brick courses heading from the surface.

APPLICATION: Brick faced walls are a natural outgrowth of solid brick walls. It was found necessary to always furr brick walls on the inside to make them sufficiently non-conductive to heat and moisture. This added considerably to the expense. The next step was to increase the inner furring sufficiently to become the bearing wall and simply face with brick for appearance. Thus resulted the real brick veneered wall. It is a most inefficient wall

A Denison Tile House to be Brick Faced Below and Stucco Surface Above

Brick over Interlocking Tile throughout the House Walls, Pergola Piers and Garden Walls

unless its weaknesses are properly safeguarded and then it becomes a most expensive wall. The lumber of which such walls are built today has a shrinkage of approximately 2% by the end of the first year in the building. This is sufficient to pull away from the veneer or if tied together to pull the veneer out of plumb, leave cracks and admit moisture and cold. Many occupants of brick veneer homes have thought they had warm strong homes until the second or third winter. The veneer cracks make cold walls, probably moisture spots, and certainly constant repair bills for maintenance. The four inches of brick is a good conductor. In order to make a warm brick veneered wall some good insulating layer must intervene between the brick and the timber; this is expensive. The brick veneer over frame makes a dangerous fire hazard having all the weaknesses described in Lesson IV and the brick veneer acts like the casing to a stove, if the fire once starts, retaining the heat and aiding the combustion of the quantity of timber. A frame house with brick veneer if properly built will cost as much as a house with solid brick walls.



A schoolhouse in Laporte, Indiana. Denison Tile Walls Faced with Brick and Stone Trimmings

With the ordinary rectangular

hollow tile the brick veneer may be added by either one of two methods. The usual process is to simply paste the brick veneer layer against the tile bearing walls and occasionally tie across with brick ties. In such a case the tile wall must be figured strong enough to carry all loads; the veneer cannot be counted on for doing more than carrying its own weight. The other method is to occasionally break the coursing of the tile to admit a header course. As the tile is not designed for receiving the headers some odd sized filler tile must be used to back up the headers. While this may be efficient in allowing the brick to be figured as part of the bearing wall it has the disadvantages of breaking the continuity of the wall, requiring several kinds of tile and hence slowing up the work and increasing the cost.

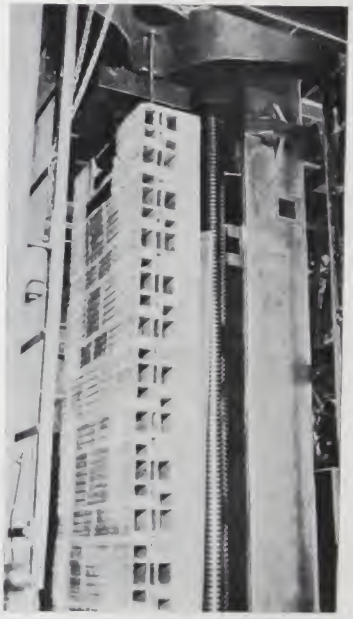
A good Example of Combining Face Brick and Stucco for Exterior Effects

An interesting Combination of Face Brick and English Cottage Exterior over Interlocking Tile

Denison Interlocking Tile is especially designed for brick bonding. Its size is a multiple of brick and every surface is dimensioned for brick. When the brick header is turned into the tile wall it finds a recess ready made into which it fits closely, is held tightly by the mortar in the dovetail grooves, and does not cause any irregularity in the wall structure. Thus the brick

A Brick Facing Headed into Denison Interlocking Tile 6½" x 12"

facing becomes an integral part of the bearing wall and the eight inches of tile and four inches of brick makes a twelve inch bearing wall equal to brick in crushing strength and much stronger in resisting lateral pressures. Nearly any desired bond pattern can be made into the Interlocking Tile without inconvenience.



Tile and Brick Wall after Test.

The strength of the brickfaced Interlocking Tile wall is proven by theory, by experience and by test. In a test conducted at the University of Illinois, eight inches of Interlocking Tile and four inches of face brick were firmly united with common header bond, as shown in the photograph. The photograph of this wall was taken immediately after the test in the machine of the University of Illinois Testing Laboratory. The weight was applied only on the tile and applying a load of 3522 lbs. per square inch of bearing web section broke out the face of the top tiles as shown. The wall costs less than a solid brick wall and no more than a properly built brick veneer over frame. It has all the advantages of being strong, fireproof, non-conductive, simple and economical.

EXPOSED TILE WALLS

TEXT: Efficiency, economy and comfort and the greatest of these is comfort.

EXPOSED TILE RESIDENCE, STEILACOOM LAKE, WASH.
Arnott Woodroofe, Tacoma, Architect.
The black and white reproduction fails to show the color blending and accentuates the contrasts.

A typical back wall to an appartment building, laid with some care but without pointing.

In order that exposed tile walls may have all the virtues of good building they must:

1. Have a Good External Appearance. There is no reason why an exposed tile wall should not satisfy the aesthetic sense as well as a brick surface except that we are not accustomed to it. There is apt to be more variation in the shading of tile than of brick but we are learning to appreciate the beauty of light and shade in an otherwise plain wall as evidenced by the demand for rough vari-shaded brick and the popularity of field stone with its varying colors. A very little selection in laying up, so that extremes of shades do not meet in adjacent tiles, results in a beautiful wall which is rapidly becoming popular in some localities even for fine residence construction. If the surface of the tile is broken with horizontal markings the result is even more satisfactory

than with a smooth surface tile. It takes little care indeed to lay up a back wall of tile which will give a better appearance than the ordinary back wall or factory wall of common brick.

2. Be Inexpensive. And aside from comfort this is the great virtue of the exposed tile wall. Consider the complexity of the ordinary wall: There may be brick facing for external appearance, weather felting for insulation, timber studding for support and lathing to hold the plaster, and then is constructed a serious fire hazard. Ordinary judgment will at once determine this to be much more expensive than the simple tile wall which accomplishes all these advantages, to a greater degree, in the one operation of proper tile laying, with the added qualities of being fire and vermin proof. Cheaper walls can be built than exposed tile walls but tile will compare favorably with ordinary timber construction.

A dark red tile laid with white mortar and all joints pointed.

3. Be Built With Tile Having Substantial Mortar Beds. The tendency for the mortar in the bearing joints to loosen and fall out under conditions of weathering and pressure must be counteracted by using tile which have at least as firm a mortar bed as brick. Tile laid with its chambers vertical so that the mortar bed of the bearing joint is but a thin layer laid on the web of the tile is manfestly unsuited for laying to

A sun porch on an exposed tile house. Note the floor and railing laid up as it is to be constructed.

the weather. Thin vertical joints, not being under pressure have no tendency to weather out if the tile is so made as to admit of the mortar's clinching within.

4. Have No Through Joints Which May Admit Moisture. Well mortared joints alone should insure against rain beating through the the wall but all mortar is absorptive and if it extends unbroken through the wall it is almost certain during damp seasons to transmit sufficient moisture by capillary attraction through the wall to appear as damp streaks or spots on the inner plaster.

An interior effect that is really very handsome.

5. Be Built of Hard Burned Tile with a very low absorption. Not so much to prevent the transmission of moisture through the wall as to prevent the weathering of the tile surface. No tile having an absorption of 12 per cent should be exposed to the weather in freezing climates. Permeation of such porous surfaces and later freezing will surely cause the tile surface to scale off.

A piece of splendid masonry work on exposed Interlocking Tile. It shows the flexibility of the tile.

SUMMARY: To give efficiency, economy and comfort exposed tile walls should be built of tile so designed and so made that the completed simple tile wall will have a good external appearance, will be proof against absorption and transmission of moisture, will be non-conductive to heat, and will securely hold the internal plaster.

APPLICATION: It will at once be evident that if the above conditions could be complied with the exposed tile wall would be practical and soon become popular. It will be realized at the same time that it would be a very extraordinary building tile which would comply with the difficult qualifications imposed; sufficient strength for support unaided; hard enough burned to be practi-

cally non-absorptive; containing within itself sufficient dead air spaces to make a non-conductive wall, with secure mortar beds insuring permanency; a tile that will lay up a wall in such a manner that there is no joint extending through the wall, and finally a tile with the proper surface to make an attractive external appearance. And yet in certain localities the exposed tile wall has become popular and has been proven practical, but only in localities where Denison Interlocking Tile is obtainable. There is probably no other form of tile manufactured today which will entirely comply with the requirements for an exposed tile wall. Denison Interlocking Tile does manifestly comply with all the qualifications above enumerated. In previous lessons, step by step, all these requirements have been discussed, except the last, and their application made to Denison Interlocking Tile. The supreme test of a hollow tile may be said to be its fitness for an exposed-tile wall.

Typical exposed Interlocking Tile construction in fine residence. A light colored tile in dark pointed mortar.

It then remains to discuss briefly the appearance of Denison Interlocking Tile when exposed in a wall. The colors vary, depending upon the factory producing the tile. Generally the color is either maroon varying to a dark red, a light red varying to a pink, a brown varying to a yellow or a buff to a cream but always from the same plant, the shades harmonizing to one color so that the variation in the wall is only that of light and shade. By construction the Interlocking Tile is splendidly designed for external appearance. The individual blocks are not of the extreme sizes found in the ordinary rectangular tile. The length of the block lies in the horizontal direction and thus the general construction offers the horizontal lines of repose, as best suits the eye. These construction lines are still further accentuated and the block surfaces

A back wall laid up without any special care. 12 in. wall below and 8 in. above.

Exposed tile factory construction.

broken up by the lines of the dovetail grooves running horizontally, giving an appearance not unlike that of Roman brick. Due to the corner and jamb tile the surface is further varied, where the grooves assume the vertical position, symbolizing strength and support about the openings and at the corners where appropriate.

The edges of the exposed surface of Denison Tile are well designed for good mortar appearance. The horizontal edges are slightly rounded and smooth, making either a raked or pointed mortar very effective while the vertical edges are abrupt and hence adapted to a flush mortar joint hardly apparent at a little distance.

The shape of the tile is conducive to many little structural variations for purposes of corbells, rails, copings, panels, almost without limit to the desire of the designer.

Exposed Interlocking Tile walls have become popular in many communities and usually by the same circumstances of evolution. Its value over a common brick wall for a back wall to a store or apartment building is so evident that it is commonly used. Some discerning architect sees the possibilities of such an exposed tile wall, if mortared with a little care, for factory or warehouse construction. Invariably the splendid appearance is a surprise, the architect is interested in seeing what a good effect he can get and specifies the exposed tile with a dark mortar, raked horizontal and flush vertical joints, in a garage or similar building. This usually leads to its use in a summer home or a boulevard residence. One attractive house is sure to result in several. The economy of such a wall especially recommends it for dairy barns, and other farm buildings, company houses, bungalows, summer cottages and such buildings where efficiency and attractiveness is essential and low expense a necessity.

Typical barn construction of exposed Interlocking Tile.

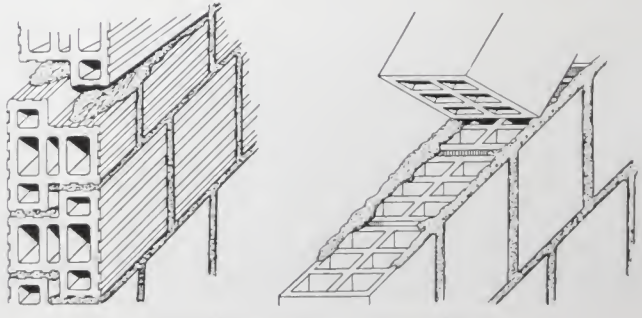
INTERIOR FINISH ON TILE WALLS

TEXT: Let the interior of the home reflect the qualities desired in the residents; neatness, firmness and stability and let it be decorated harmoniously in softening tones

That the interior finishing of tile walls may be superior to that of any other wall in permanency, economy and beauty it is essential that the following suggestions be observed during construction:

A pleasing interior of a fireproof home plastered directly on the tile

1. The Tile Must Be Firmly Bedded. In bearing walls if the tile is set on end thus allowing only a thin mortar bed on the narrow webs the side thrusts on the wall will almost surely cause sufficient toppling of the tile to result in horizontal cracking of the internal plaster. The horizontal joints are the weight bearers and their mortar beds should be wide and strong and if possible these joints should not extend unbroken through the wall. In non-bearing partitions the strength of the mortar bed is of much less importance. If rectangular tiles are used in such partitions, however, the strength of the wall will be considerably augmented by laying the tile on edge instead of on end.



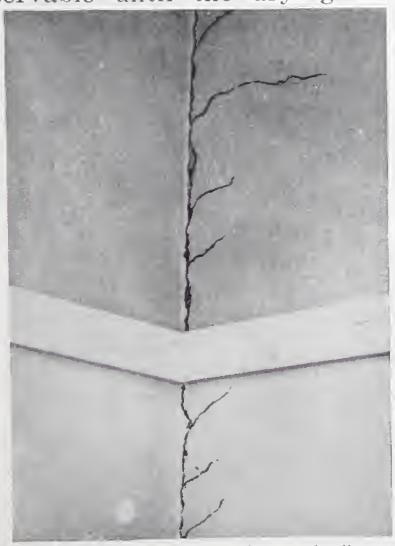
Examples of firm and infirm bedding

2. Exterior Walls Must Be Moisture Proof. All the principles taught in Lesson III must be observed to prevent transmission and condensation of moisture.

3. There Must Be No Solid Parts in the Wall. A properly built tile wall is so proof against condensation of moisture on its internal surface that the insertion of even a few solid brick or concrete lintels upon which the plaster is directly spread will at times condense sufficient moisture to show as damp spots on the plaster.

4. The Tile Should Be Horizontally Grooved. As the plaster is applied its tendency is to slide down on the wall. This tendency may not result in cracks observable until the drying out of the plaster. Vertical grooves are not as efficient against this tendency as horizontal grooves any more than lath would be when applied vertically. Cement plaster is not dependent upon the grooves for holding in place after it has set but lime plaster and most patent plasters cling to the wall by frictional tentacling and are dependent upon horizontal grooves for permanency. The grooves should be slightly dovetailed to provide a strong plaster key.

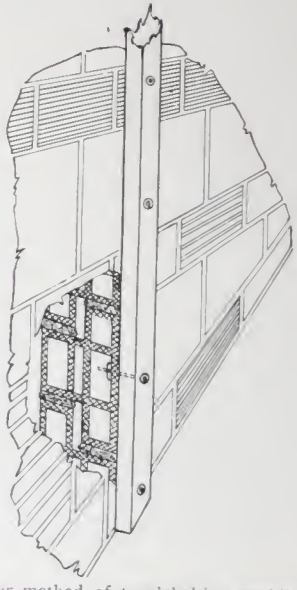
This wall was plastered down to the line. Later an effort was made to cut away some of the plaster in order to apply a marble wainscot. The photograph shows how tenaciously the cement plaster clings to the hard tile.



A typical plaster crack occurring at the line of contact of a frame partition improperly attached to a tile wall.

5. Frame Partitions Must Be Firmly Joined to Tile Walls at place of contact. Tile and plaster have practically the same

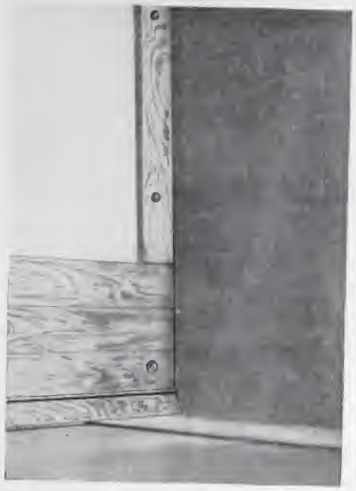
coefficient of expansion. There is no likelihood of any plaster cracks occurring when plaster is applied to a properly constructed tile wall. What are commonly called "settlement cracks" on frame or wood furred walls are very rarely due to any settlement of the walls but are caused directly by the tremendous shrinkage of the lumber as it dries out in the wall. Some builders still insist upon making internal partitions of frame. When such frame partitions meet the tile bearing wall there commonly occurs during the first year a large unsightly plaster crack. While plaster cracks over frame walls cannot be entirely eliminated this large corner crack can be if the frame partition is properly toggle-bolted to the tile at the line of contact.



The proper method of togglebolting studding of a frame partition to a tile wall.

6. Provision Must Be Made for Secure Fastening of Internal Trim. The usual method is by providing "grounds" to which the trim is later attached by nailing. The grounds are soft wood strips of the same thickness as the plaster which are securely fastened to the tile wherever the trim is to be applied. The methods of fastening the grounds are many. An ordinary one is to lay into the joints of the tile, where required, thin wood strips or blocks which form nailing holds to

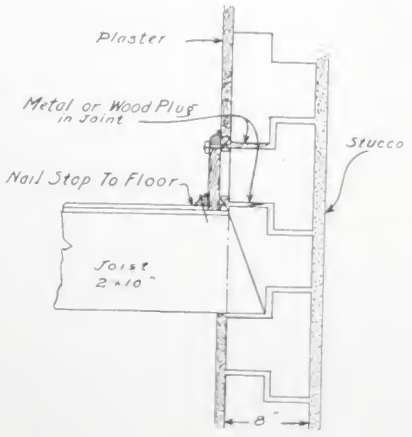
Nailing strips for grounds of the base board inserted between the tile as they are laid up.



An example of trim fixed directly to the tile with toggle bolts.

which the trim is nailed. Many good devices are manufactured for this same purpose such as the clinching nail and the corrugated wall plug. In hotels and large office buildings another method is becoming popular, is economical and very effective: No provision is made for the trim before plastering. The trim strip is put in place and held solidly by means of small toggle bolts at regular intervals. The toggle bolts are provided with decorative heads and add to rather than detract from the finished appearance of the trim.

7. With Timber Floors Their Shrinkage Should Be Provided for in Applying the Floor Mould. Soft timber floor joists are especially liable to extensive shrinkage, the tile wall will not shrink. When the baseboard is firmly fixed to the tile wall the floor will shrink away from it. If the floor mould is firmly attached to the baseboard an ugly crack will soon appear between the floor and the mould such as is often seen in frame houses. This can be entirely avoided if the floor mould is firmly pressed against the baseboard but held there chiefly by being securely nailed to the finished floor.



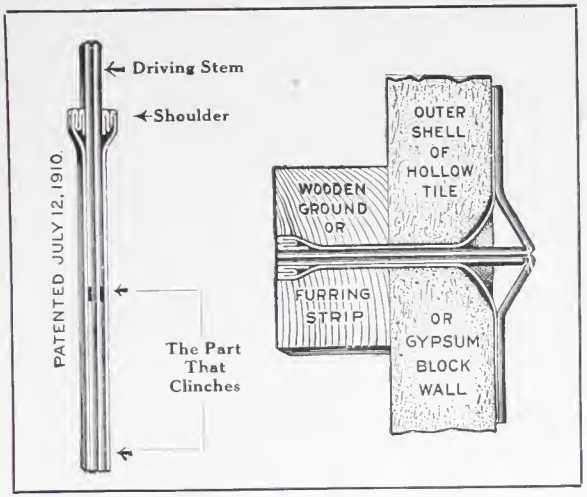
The proper application of the floor mould.

SUMMARY. Plaster cracks and gaping trim, quite unpreventable in frame construction, may be entirely avoided when walls are built of a firmly bedded, interlocking, nonconductive tile with horizontal plaster grooves if ordinary foresight is used in applying the trim.

The grounds attached with self-clinching nails in the Nurses Home. German Hospital, Philadelphia, Pa.

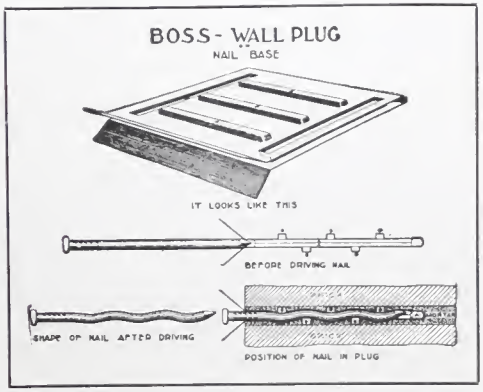
APPLICATION: Again referring to the evolution of building construction, especially as it has had to do with internal decoration of walls, we find the early period solid wall generally exposing its structural material within, frequently it was smoothed or carved and pointed, often its damp cold surfaces were hidden with hanging tapestries or erected screens. At first attempts at plastering these solid walls were failures in ordinary climates. The condensation of moisture on the solid wall soon destroyed the permanency of the plaster coat. It was found necessary to add an artificial surface by some form of furring and lathing which would provide an air space back of the plaster and a clinging surface. With this expense had been added not only a lack of permanency but a dangerous fire hazard. In certain European localities these undesirable elements were largely eliminated by using hollow tile with which to furr for plaster. Indeed in certain localities there are in use today very old and well preserved buildings which stand as evidence of progressive minds reaching into the future and devising walls built wholly of hollow tile successfully plastered directly on the tile. But it is only in a recent day that a mind by long construction experience made

peculiarly astute to the necessity, has designed a hollow tile which alone is adapted to perform perfectly all the functions required of a perfect bearing wall from supporting structural weight to being so non-conductive and impervious to moisture as to permanently retain the plaster coats on its inner surface and at the same time be exposed to the extremes of weather on its outer surface.



Illustrating the application of grounds by means of the self-clinching nail.

Denison Interlocking Tile with its four inch mortised mortar bed so resists the strains as to avoid the horizontal cracks so bothersome on walls built of rectangular tiles. The horizontal dovetailed grooves make any internal plaster easy of application and tenaciously permanent. The numerous separate and horizontal dead air chambers make a wall so nonconductive as to insure against surface condensation and thus provides a permanently dry plaster surface. The solid bedding of the Interlocking Tile offers secure holding for the grounds and its horizontal chambers and staunch webs provide sure and easy application of toggle-bolts.



Illustrating the application of grounds by means of a metal wall plug.

A Primer of Good Building--Lesson XIII

A REVIEW LESSON

TEXT: The best is none too good when it's your own.

MT. ST. MARY'S HOSPITAL, NIAGARA FALLS, N. Y.
A seven story bearing wall building constructed of Denison Interlocking Tile

The characteristics of the Best Wall are:

Lesson I. THE WALL MUST BE STRONG, not only against pressure but against time. To insure this its component parts should interlock, thus providing against through mortar joints and they should provide a four-inch dove-tailed mortar bed.

The non-conductivity of Interlocking Tile walls is splendidly shown by its special fitness for cold storage warehouses

Lesson II. THE WALL MUST BE NON-CONDUCTIVE to insure comfort, permanency, sanitation and economy. To accomplish this its component parts must be of a non-absorptive material and must provide horizontal non-communicating dead air spaces in sufficient number.

Dry walls are absolutely necessary in nursery storage houses. The success of Interlocking Tile for this class of buildings has been remarkable

Lesson III. THE WALLS MUST BE ALWAYS DRY. To be sure of this the wall must be impervious, must have no solid portion or joint extending through the wall which will allow absorption through the wall. The inner shell of the wall must be insulated from the outer by non-communicating dead air spaces to prevent sweating.

Lesson IV. The Walls Should Be Entirely Fireproof not only non-flammable but not disintegrate at high temperatures and must prevent transmission of heat through vertical flues or by radiation, which means that all component parts must have previously withstood high temperatures and must build a non-conductive wall.

A lumber kiln of Interlocking Tile which stood unharmed after all lumber piles inside and out and surrounding buildings were destroyed by fire

Lesson V. The Foundation should have all the qualifications possessed by the walls it supports and be so continuous with them as to transmit the stability of the foundation to the superstructure through a perfectly continuous bond.

Building a strong dry foundation of Interlocking Tile

Lesson VI. The Wall Must Provide a Mutually Supporting Bearing for Floors without being weakened by broken coursing, through joints, or foreign filling.

Continuing the unbroken coursing of Interlocking Tile above the floor level

A Primer of Good Building--Lesson XIII

The simple attachment of a large roof on a dairy barn built of exposed Interlocking Tile

Lesson VII. The Outward Roof Thrust must be strongly guarded against. To accomplish this, the component parts must provide against the tendency to topple from or slue on the mortar joint and must transmit the lateral thrust to lower courses as a downward pressure and also allow a firm attachment of the roof plates.

A typical example of the flexibility and strength of Interlocking Tile about wall openings

Lesson VIII. The Wall Must Be Strengthened About Openings to withstand the arching of the strains above. Acceptable building material should make walls which provide the additional strength necessary around openings and fit air-tightly about the frames without interfering with the freedom of decoration or greatly increasing the cost.

A detail of artistic stucco design, over Denison Interlocking Tile

Lesson IX. The Backing Wall for Exterior Stucco must have the same co-efficient of expansion as the stucco; it must not disintegrate upon exposure; it must have an absorption under 12 per cent; it must not sweat; it must not contain soluble salts; it must present a plumb surface grooved horizontally.

The A B C of Good Construction--Lesson XIII

Lesson X. For An Efficient Brick Veneered Wall the backing wall must be of similar material to the brick and its component parts so designed as to receive the brick header courses making the veneer an integral part of the bearing wall.

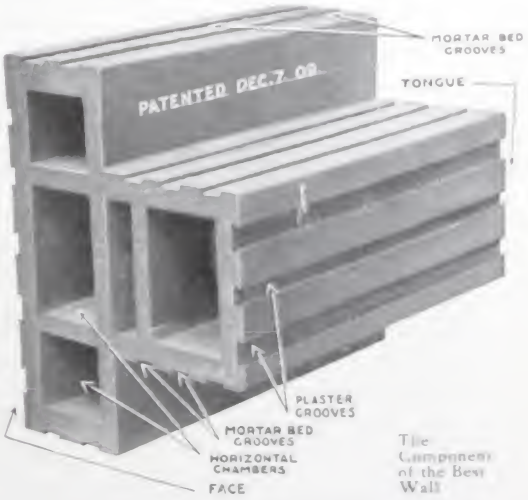
A colonial style, brick veneer over Interlocking Tile

Lesson XI. Exposed Tile Walls should be built of tile so designed and so made that the completed simple tile wall will have a good external appearance, will be proof against absorption and transmission of moisture, will be non-conductive to heat, and will securely hold the internal plaster.

A detail of an exposed Interlocking Tile residence, eight-inch wall

Lesson XII. The Interior Finish on Tile Walls need show no plaster cracks, gaping trim or damp spotted walls so unpreventable in frame construction, providing the walls are built of a firmly bedded, interlocking, non-conductive tile with horizontal plaster grooves and if ordinary foresight is used in applying the trim.

THE ULTIMATE LESSON. Denison Interlocking Tile is the Only Building Material yet manufactured which fulfills all of the conditions imposed for The Best Wall.



The Component of the Best Wall

Illustrating the Rapidity and Simplicity With Which Denison Tile Are Laid Up

Manner of Starting Corner of 12″ Wall.

Spreading Mortar Bed 15′ along the Wall.

Laying up 15 Lineal Feet of Tile on Mortar Bed

Section of 132 Lineal Feet, 12″ Wall, 4 Ft. High, Laid by Two Men in 8 Hours.

Denison Interlocking Tile Manufacturers and Representatives

Parties wishing additional information should write the nearest representative.

Alberta Clay Products Co., Ltd.	Medicine Hat, Alberta, Can.
American Clay Products Co., Inc., 175 Fifth Ave.	New York City.
American Fire Brick Co.	Spokane, Wash.
W. J. Bailey	San Diego, Calif.
Buffalo Builders Supply Co.	Buffalo, N. Y.
California Denison Block Co.	San Francisco, Calif.
The Clay Products Co., Stock Exchange Bldg.	Chicago, Ill.
N. G. DeHass, Harlow Block	Marquette, Mich.
The Delaware Clay Mfg. Co.	Delaware, O.
The Denison Clay Co., Kellogg Bldg.	Coffeyville, Kan.
Far West Clay Co., 226 Tacoma Bldg.	Tacoma, Wash.
Far West Clay Construction Co., 223 Tacoma Bldg.	Tacoma, Wash.
Far West Clay Co., 210 Hoge Bldg.	Seattle, Wash.
Canadian Denison Tile Co., Limited	Vancouver, B. C.
Fraser Brick Co., Sumpter Bldg.	Dallas, Texas.
Georgia-Carolina Brick Co., Irish-Am. Bank Bldg.	Augusta, Ga.
W. L. Hammar	Corpus Christi, Texas
Houston Brothers Co.	Pittsburgh, Pa.
Wm. S. Humbert, Inc.	Niagara Falls, N. Y.
Indiana Builders' Supply Co., 703 Furniture Bldg.	Evansville, Ind.
H. O. Johnson, 8 North 6th St.	Minneapolis, Minn.
Kansas Buff Brick & Mfg. Co.	Buffville, Kans.
Laclede-Christy Clay Products Co.	St. Louis, Mo.
Los Angeles Denison Block Co., 502 Frost Bldg.	Los Angeles, Cal.
Louisville Builders' Supply Co., 703 Realty Bldg.	Louisville, Ky.
W. L. Macatee & Sons	Houston, Texas.
R. J. Madden	Galveston, Texas.
A. D. Morris	Shreveport, La.
Neff-Stiles Co.	El Paso, Texas.
The Ohio Clay Co., 816 Hippodrome Bldg.	Cleveland, O.
Oregon Denison Block Co., Chamber Com. Bldg.	Portland, Ore.
The Pursell Grand Co.	Cincinnati, O.
Ricketson & Schwarz, University Bldg.	Milwaukee, Wis.
Standard Salt & Cement Co., 237 Lake Ave., South	Duluth, Minn.
States Engineering Co., 504 Free Press Bldg.	Detroit, Mich.
J. S. Schirm	San Diego, Calif.
Suburban Brick Co.	Moundsville, W. Va.
Sun Brick Co., Ltd., Traders Bank Bldg.	Toronto, Canada.
The Warner-Miller Co., Railroad Ave.	New Haven, Conn.
Western Clay Manufacturing Co.	Helena, Mont.
Youngstown Ice Co.	Youngstown, Ohio.
A. B. Meyer & Co., 17-19 North Pennsylvania St.	Indianapolis, Ind.
Staples-Hildebrand Co.	South Bend, Ind.
Calumet Supply Co.	Gary, Ind.
Morehouse & Wells Co.	Decatur, Ill.

Manufacturing rights in open territory may be secured by reliable clay products manufacturers from the Denison Tile Engineering Co., 816 Hippodrome Bldg., Cleveland, O.